

Group: **Chiller**Part Number: **330412001**Date: **October 2005**Supersedes: **IMM AGS-1**

GeneSysTM Air-Cooled Screw Compressor Chiller

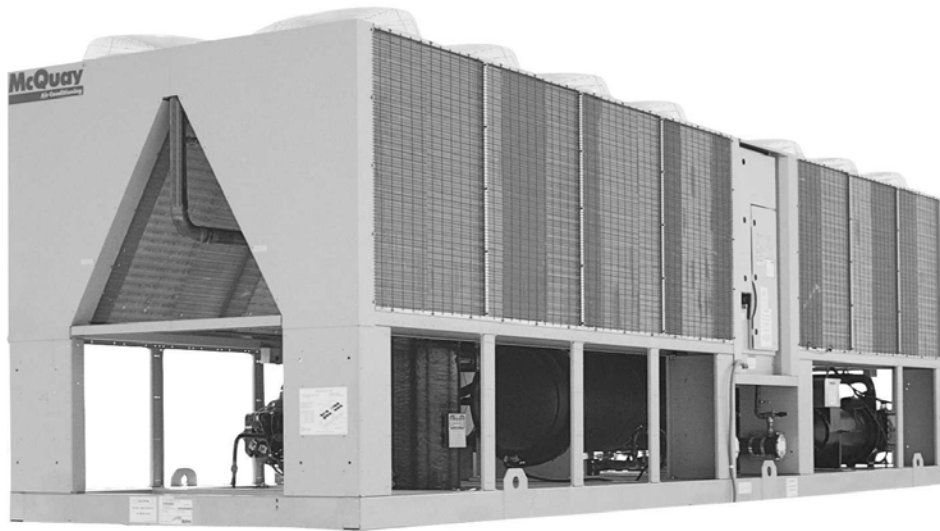
AGS 230B through AGS 475B**60 Hertz****R-134a**

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Unit controllers are LONMARK
certified with the optional LONWORKS
communications module.

Manufactured in an ISO Certified facility

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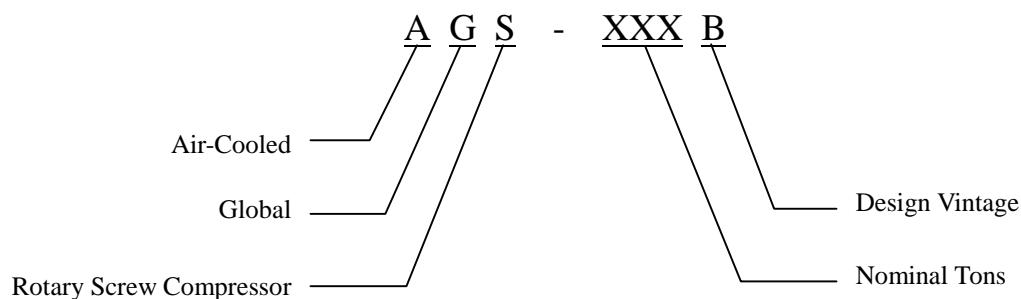
Introduction

General Description

McQuay **GeneSys™** air-cooled water chillers are complete, self-contained, automatic refrigerating units that include the latest in engineered components, arranged to provide a compact and efficient unit. Each unit is completely assembled, factory wired, evacuated, charged, tested and comes complete and ready for installation. Each unit consists of multiple air-cooled condenser sections with integral subcooler sections, each with a semi-hermetic single-screw compressor, solid-state starter, a multiple-circuit shell-and-tube flooded evaporator, and complete refrigerant piping. Each compressor has an independent refrigeration circuit. Liquid line components included are manual liquid line shutoff valves, charging ports, filter-driers, sight-glass/moisture indicators, and electronic expansion valves. A discharge check valve is included and a compressor suction shutoff valve is optional. Other features include compressor heaters, evaporator head heaters, automatic one-time pumpdown of refrigerant circuit upon circuit shutdown, and an advanced fully integrated microprocessor control system.

Information on the operation of the unit and on the MicroTech II controller are in the OM AGS manual. Installation and operating instructions will be shipped with the unit if a LONTALK®, Modbus® or BACnet® BAS interface is ordered.

Nomenclature



Inspection

When the equipment is received, check all items carefully against the bill of lading to check for a complete shipment. Carefully inspect for damage upon arrival. Report shipping damage to the carrier and file a claim with the carrier. Check the unit's serial plate before unloading the unit to be sure that it agrees with the power supply available. Physical damage to unit after acceptance is not the responsibility of McQuay International.

Note: Unit shipping and operating weights are shown in the Physical Data Tables on page 27.

Installation and Start-up

Note: Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment.



WARNING

**Sharp edges and coil surfaces are a potential injury hazard.
Avoid contact with them.**

Start-up by McQuayService is included on all units sold for installation within the USA and Canada and must be performed by them to initiate the standard limited product warranty. Two-week prior notification of start-up is required. The contractor should obtain a copy of the Start-up Scheduled Request Form from the McQuay sales representative or from the nearest office of McQuayService.

Handling

Avoid rough handling or shock due to impact or dropping the unit. Do not push or pull the unit.

Never allow any part of the unit to fall during unloading or moving as this can result in serious damage.

To lift the unit, lifting tabs with 2½" (64 mm) diameter holes are provided on the base of the unit. All lifting holes must be used when lifting the unit. Arrange spreader bars and cables to prevent damage to the condenser coils or unit cabinet (see Figure 1).



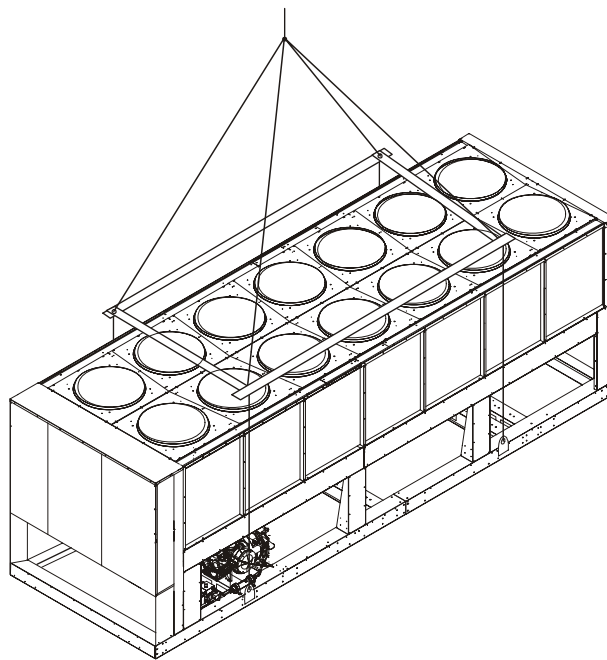
DANGER

Improper lifting or moving unit can result in property damage, severe personal injury or death. Follow rigging and moving instructions carefully.

Figure 1, Required Lifting Method

NOTES:

1. All rigging points on a unit must be used. See page 16 through page 18 for location, and weight at lifting points for a specific size unit.
2. Crosswise and lengthwise spreader bars must be used to avoid damage to unit. Lifting cables from the unit mounting holes up must be vertical.
3. The number of lifting points, condenser sections, and fans can vary from this diagram.



Location

Locate the unit to provide proper airflow to the condenser. (See Figure 2 on page 6 for required clearances).

Due to the shape of the condenser coils on the AGS chillers, orient the unit so that prevailing winds blow parallel to the unit length, thus minimizing the wind effect on condensing pressure and performance. If low ambient temperature operation is expected, it is recommended that optional wind baffles or louvers be field installed if the unit has no protection against prevailing winds.

Using less clearance than shown in Figure 2 can cause discharge air recirculation to the condenser and could have a significant detrimental effect on unit performance.

See Restricted Airflow beginning on page 7 for further information.

Service Access

Compressors, filter-driers, and manual liquid line shutoff valves are accessible on each side of the unit adjacent to the control box. The evaporator heaters are located in each head.

Each compressor (two or three depending on unit size) has its own duplex control panel located on the sides of the chiller between condenser coil sections. A control panel is to the left of the condenser and compressor it controls. The outer control box contains the circuit microprocessor. The box for circuit #1 also contains the unit microprocessor controller. The solid state compressor starter, fan control and other power equipment are located in the inner panel.

The side clearance required for airflow provides sufficient service clearance.

On all AGS units the condenser fans and motors can be removed from the top of the unit. The complete fan/motor assembly can be removed for service. The fan must be removed for access to wiring terminals at the top of the motor.



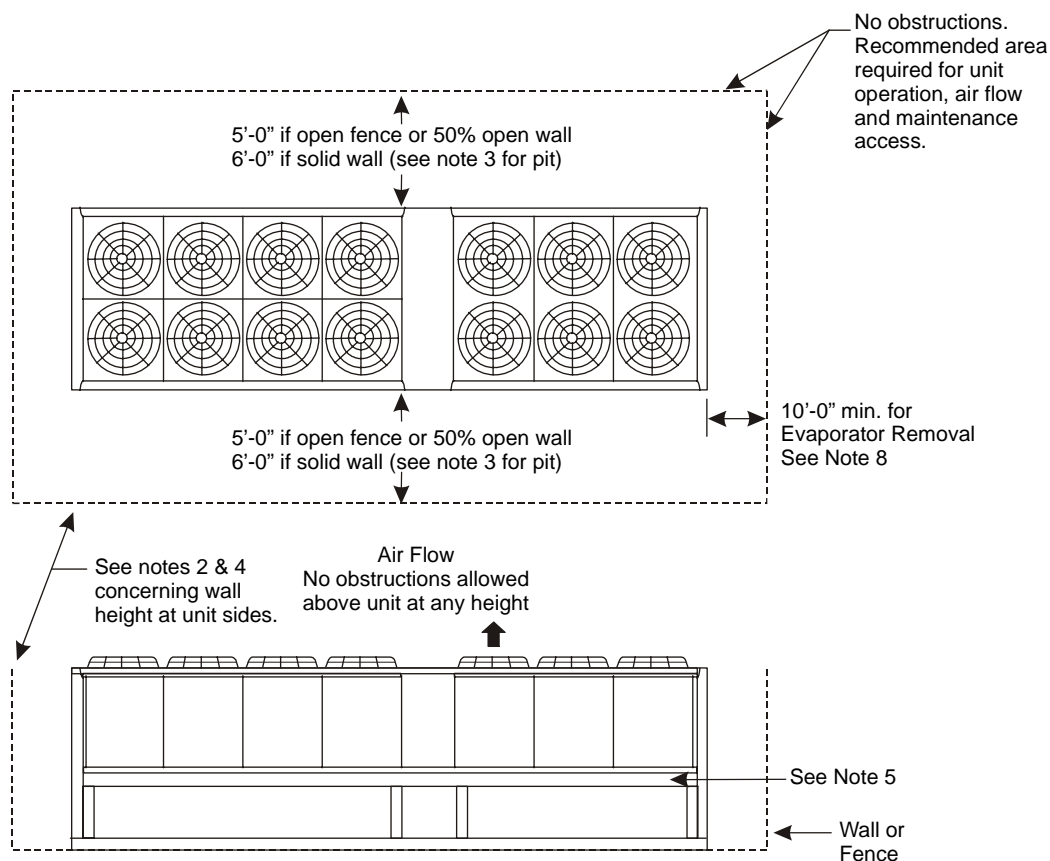
WARNING

**Disconnect all power to the unit while servicing condenser fan motors or compressors.
Failure to do so can cause bodily injury or death.**

Do not block access to the sides or ends of the unit with piping or conduit. These areas must be open for service access. Do not block any access to the control panels with a field-mounted disconnect switches. In particular, be sure that the power conduit to each panel does not interfere with access to the filter-driers located on the unit base under the panels.

Clearance Requirements

Figure 2, Clearance Requirements, AGS 230B – 475B



Notes:

1. Minimum side clearance between two units is 12 feet (3.7 meters).
2. Unit must not be installed in a pit or enclosure that is deeper or taller than the height of the unit unless extra clearance is provided per note 4.
3. Minimum clearance on each side is 8 feet (2.4 meters) when installed in a pit no deeper than the unit height.
4. Minimum side clearance to a side wall or building taller than the unit height is 6 feet (1.8 meters), provided no solid wall above 6 feet (1.8 meters) is closer than 12 feet (3.7 meters) to the opposite side of the unit.
5. Do not mount electrical conduits where they can block service access to compressor controls, refrigerant driers or valves.
6. There must be no obstruction of the fan discharge.
7. Field installed switches must not interfere with service access or airflow.
8. The 10-ft. clearance required for removal of the evaporator is on the end that the evaporator connections face. See dimension drawings on page 30 for details.
9. See the following pages if the airflow clearances cannot be met.

Restricted Airflow

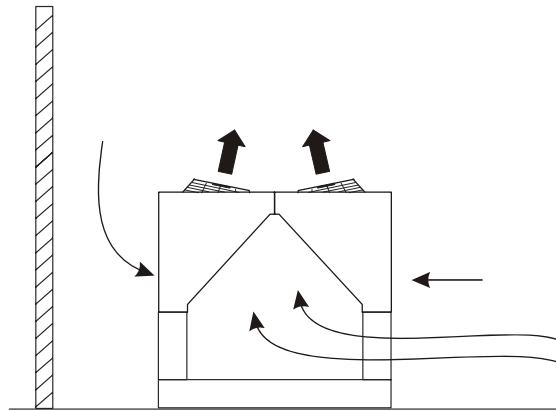
General

The clearances required for design operation of AGS air-cooled condensers are described in the previous section. Occasionally, these clearances cannot be maintained due to site restrictions such as units being too close together or a fence or wall restricting airflow, or both.

The McQuay AGS chillers have several features that can mitigate the problems attributable to restricted airflow.

- The “W” shape of the condenser section allows inlet air for these coils to come in from both sides and the bottom. All the coils in one “W” section serve one compressor. Every compressor always has its own independent refrigerant circuit.
- The MicroTech II™ control is proactive in response to off-design conditions. In the case of single or compounded influences restricting airflow to the unit, the microprocessor will act to keep the compressor(s) running (at reduced capacity) as long as possible, rather than allowing a shut-off on high discharge pressure.

Figure 3, Coil and Fan Arrangement



The following sections discuss the most common situations of condenser air restriction and give capacity and power adjustment factors for each. Note that in unusually severe conditions, the MicroTech II controller would adjust the unit operation to remain online until a less severe condition is reached.

Case 1, Building or Wall on One Side of One Unit

The existence of a screening wall, or the wall of a building, in close proximity to an air-cooled chiller is common in both rooftop and ground level applications. Hot air recirculation on the coils adjoining the wall will increase compressor discharge pressure, decreasing capacity and increasing power consumption.

When close to a wall, it is desirable to place chillers on the north or east side of them. It is also desirable to have prevailing winds blowing parallel to the unit's long axis. The worst case is to have wind blowing hot discharge air into the wall.

Figure 4, Unit Adjacent to Wall

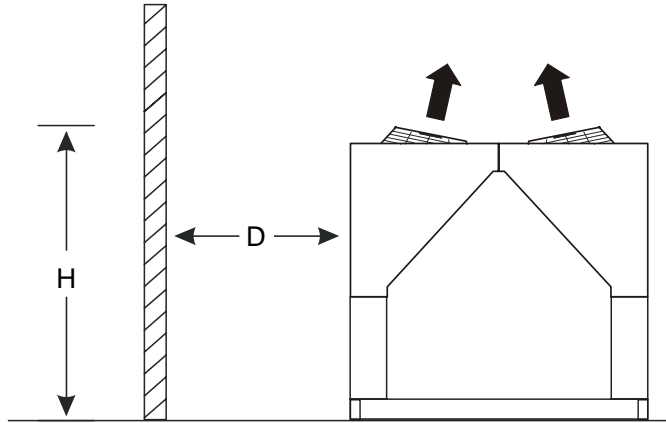
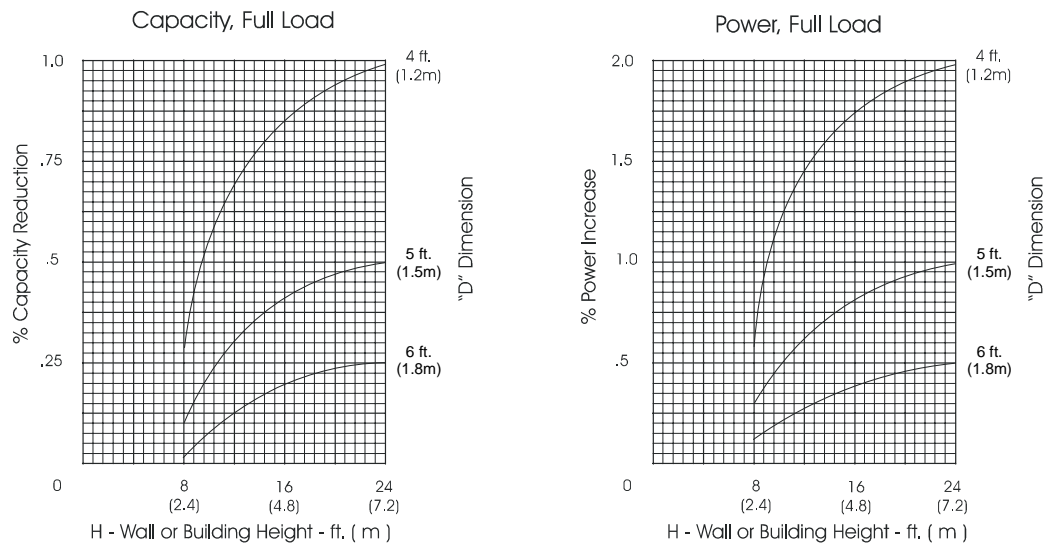


Figure 5, Adjustment Factors



Case 2, Two Units Side By Side

Two or more units sited side by side are common. If spaced closer than 12 feet (3.7 meters) it is necessary to adjust the performance of each unit; circuits adjoining each other are affected. If one of the two units also has a wall adjoining it, see Case 1. Add the two adjustment factors together and apply to the unit located between the wall and the other unit.

Mounting units end to end will not necessitate adjusting performance. Depending on the actual arrangement, sufficient space must be left between the units for access to the control panel door opening and/or evaporator tube removal. See “Clearance” section of this guide for requirements for specific units.

Pit or solid wall surrounds should not be used where the ambient air temperature exceeds 105°F (40°C).

Figure 6, Two Units Side by Side

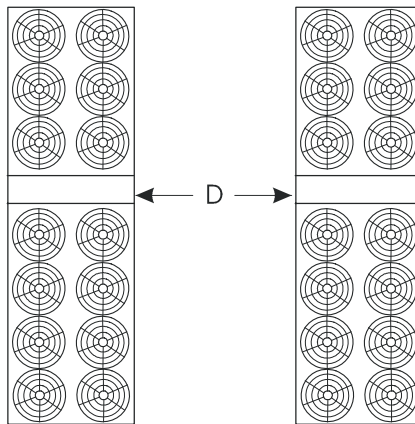
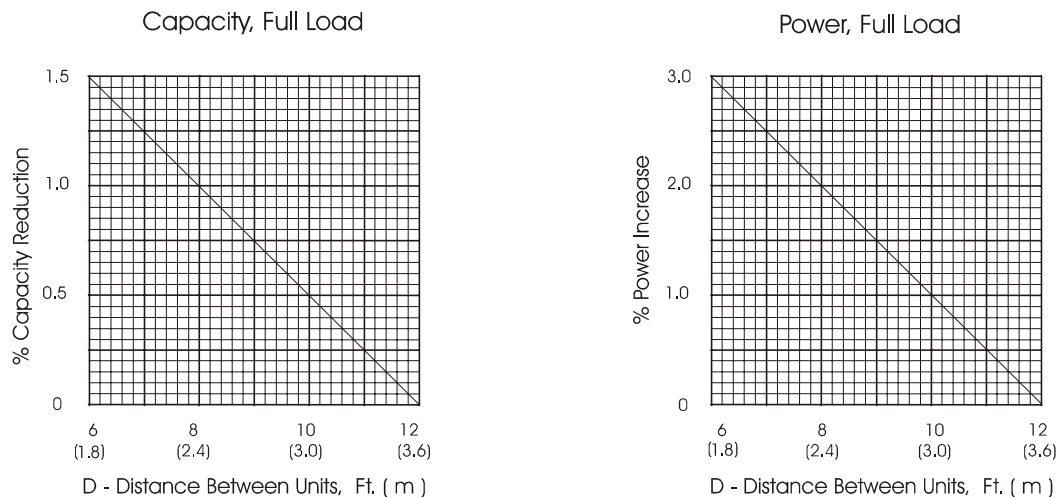


Figure 7, Adjustment Factor



Case 3, Three or More Units Side By Side

When three or more units are side by side, the outside units (chillers 1 and 3 in this case) are influenced by the middle unit only on their inside circuits. Their adjustment factors will be the same as Case 2. All inside units (only chiller 2 in this case) are influenced on both sides and must be adjusted by the factors shown below.

Figure 8, Three or More Units

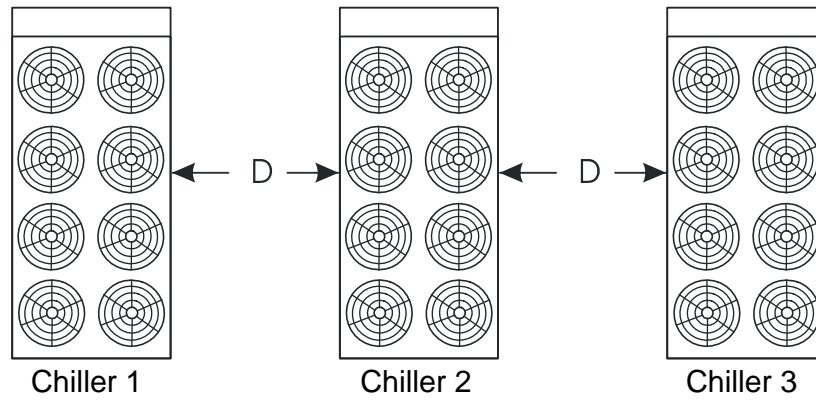
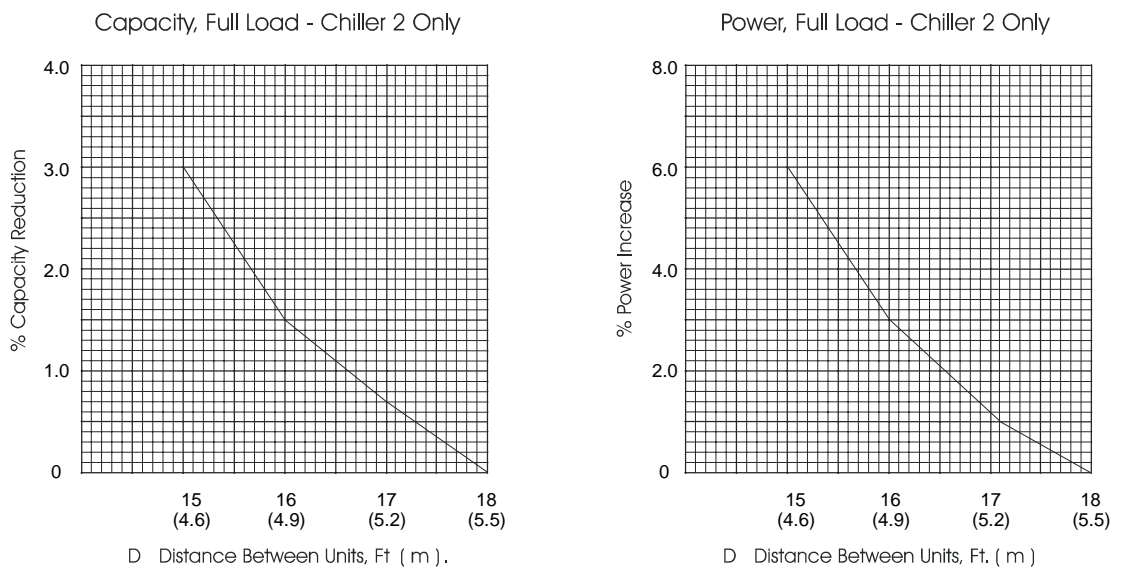


Figure 9, Adjustment Factor



Case 3, Open Screening Walls

Decorative screening walls are often used to help conceal a unit either on grade or on a rooftop. These walls should be designed such that the combination of their open area and distance from the unit do not require performance adjustment. It is assumed that the wall height is equal to, or less than the unit height when mounted on its base support. This is usually satisfactory for concealment. If the wall height is greater than the unit height, see Case 4, Pit Installation.

The distance from the sides of the unit to the side walls should be sufficient for service and opening control panel doors.

If each side wall is a different distance from the unit, the distances can be averaged, providing either wall is not less than 8 feet (2.4 meters) from the unit. For example, do not average 4 feet and 20 feet to equal 12 feet.

Figure 10, Open Screening Walls

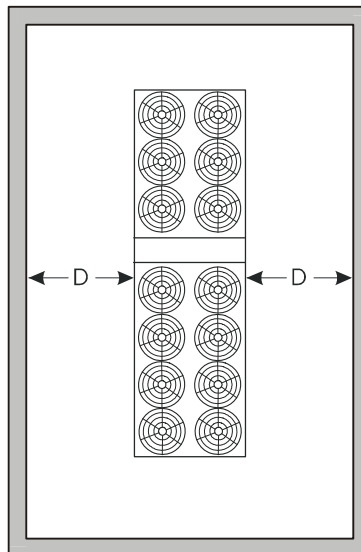
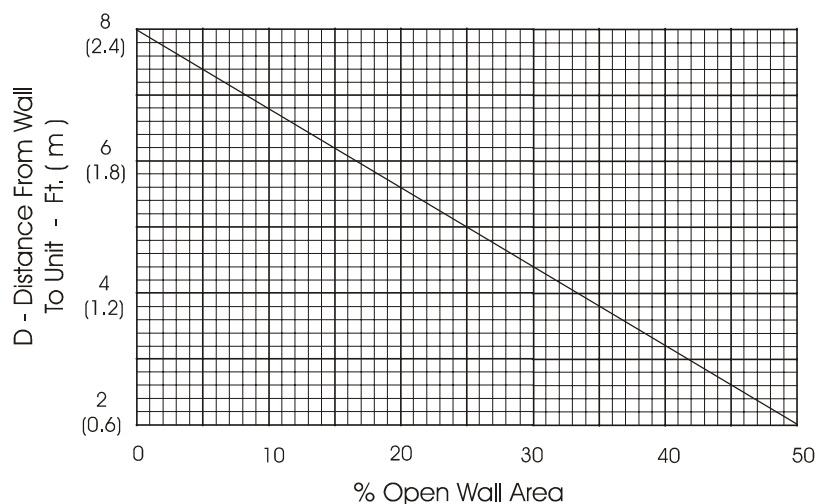


Figure 11, Wall Free Area vs. Distance



Case 4, Pit/Solid Wall Installation

Pit installations can cause operating problems and great care should be exercised if they are to be used on an installation. Recirculation and restriction can both occur. A solid wall surrounding a unit is substantially the same as a pit and the data presented in this case should be used.

Steel grating is sometimes used to cover a pit to prevent accidental falls or trips into the pit. The grating material and installation design must be strong enough to prevent such accidents, yet provide abundant open area or serious recirculation problems will occur. Have any pit installation reviewed by McQuay application engineers prior to installation to discuss whether it has sufficient airflow characteristics. The installation design engineer must approve the work and is responsible for design criteria.

Figure 12, Pit Installation

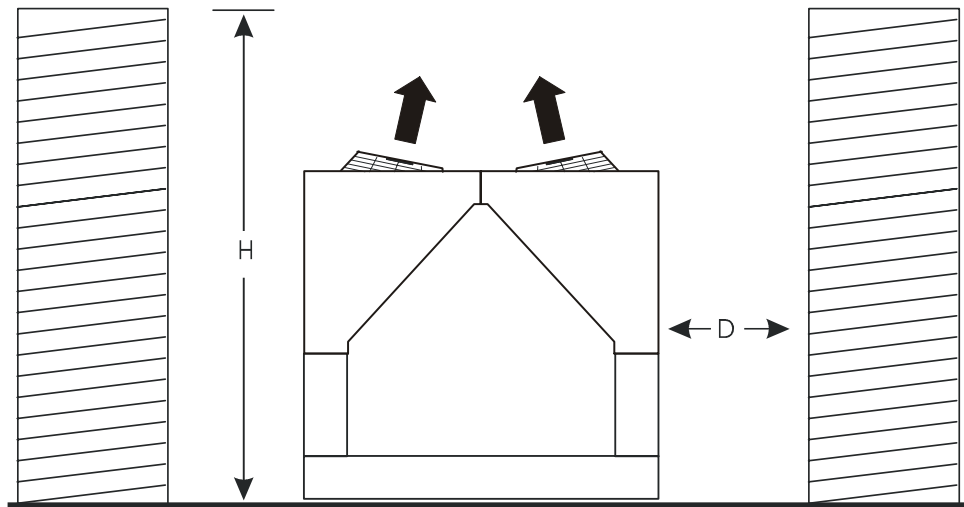
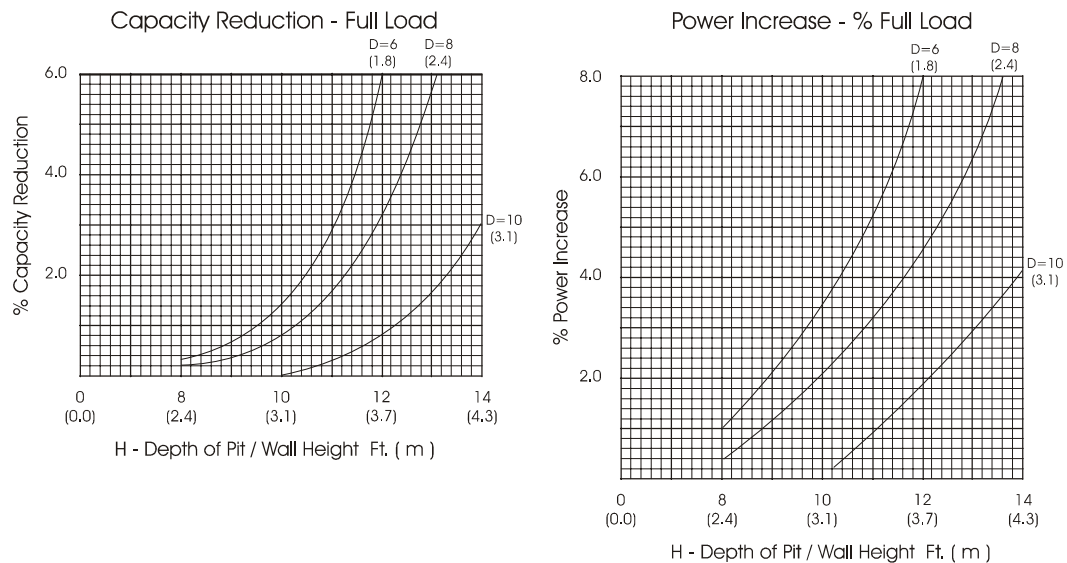


Figure 13, Adjustment Factor



Vibration Isolators

Vibration isolators are recommended for all roof-mounted installations or wherever vibration transmission is a consideration. The following section "Lifting and Mounting Weights" contains the location of unit lifting holes and the load at each location. Mounting holes dimensions and the bearing weight at each hole given.

Table 1, Spring Flex Isolator Data

Housing	Spring Color	Max. Load Each Lbs. (kg)	Defl. In. (mm)	Dimensions In. (mm)					Housing Part Number	Spring Part Number
				A	B	C	D	E		
CP-2-27	Orange	1500 (681)	0.5 (12.7)	10.2 (259.1)	9.0 (228.6)	7.7 (195.6)	2.7 (68.6)	5.75 (146.0)	226103B-00	(2) 226117A-00
CP-2-28	Green	1800 (815)	0.5 (12.7)	10.2 (259.1)	9.0 (228.6)	7.7 (195.6)	2.7 (68.6)	5.75 (146.0)	226103B-00	(2) 226118A-00
CP-2-31	Gray	2200 (998)	0.5 (12.7)	10.2 (259.1)	9.0 (228.6)	7.7 (195.6)	2.7 (68.6)	5.75 (146.0)	226103B-00	(2) 226119A-00
CP-2-32	White	2600 (1180)	0.5 (12.7)	10.2 (259.1)	9.0 (228.6)	7.7 (195.6)	2.7 (68.6)	5.75 (146.0)	226103B-00	(2) 226120A-00

Table 2, Neoprene-in-Shear Isolator Data

Type		Max. Load Each Lbs. (kg)	Defl. In. (mm)	Dimensions In. (mm)								McQuay Part Number
				A	B	C	D (1)	E	H	L	W	
RP-4	Black	1500 (681)	0.25 (6.4)	3.75 (95.3)	0.5 (12.7)	5.0 (127.0)	0.56 (14.2)	0.25 (6.4)	1.6 (41.1)	6.5 (165.1)	4.6 (116.8)	216398A-04
RP-4	Red	2250 (1019)	0.25 (6.4)	3.75 (95.3)	0.5 (12.7)	5.0 (127.0)	0.56 (14.2)	0.25 (6.4)	1.6 (41.1)	6.5 (165.1)	4.6 (116.8)	216398A-01
RP-4	Green	3300 (1497)	0.25 (6.4)	3.75 (95.3)	0.5 (12.7)	5.0 (127.0)	0.56 (14.2)	0.25 (6.4)	1.6 (41.1)	6.5 (165.1)	4.6 (116.8)	216398A-03

Note (1) "D" is the mounting hole diameter.

Figure 14, Spring Flex Mountings

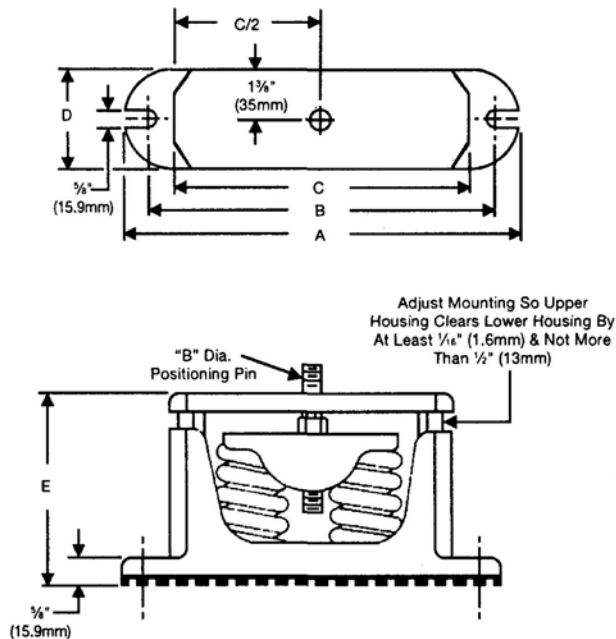


Figure 15, Single Neoprene-in-Shear Mounting

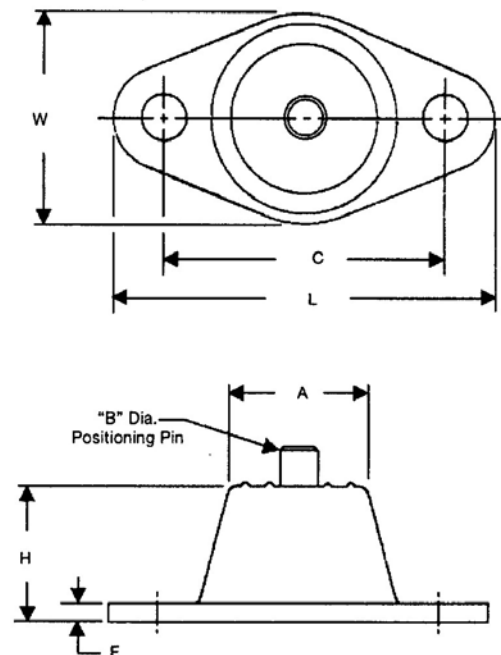


Table 3, Spring Vibration Isolators, AGS 230 – 320, Part Numbers and Spring Colors

Model	Mounting Location (See Footprint Drawings Figure 16 or Figure 17)								Kit Number
	M1	M2	M3	M4	M5	M6	M7	M8	
AGS230	CP-2-28	CP-2-31	CP-2-28	CP-2-31	CP-2-31	CP-2-28	CP-2-31	CP-2-28	350348101
	Green	Gray	Green	Gray	Gray	Green	Gray	Green	
AGS250	CP-2-28	CP-2-31	CP-2-28	CP-2-31	CP-2-32	CP-2-31	CP-4-26	CP-2-28	350348102
	Green	Gray	Green	Gray	White	Gray	Purple	Green	
AGS270	CP-2-28	CP-4-26	CP-2-31	CP-2-32	CP-2-32	CP-2-31	CP-4-26	CP-2-28	350348103
	Green	Purple	Gray	White	White	Gray	Purple	Green	
AGS300	CP-2-28	CP-4-26	CP-2-31	CP-2-32	CP-2-32	CP-2-31	CP-4-26	CP-2-28	
	Green	Purple	Gray	White	White	Gray	Purple	Green	
AGS320	CP-2-28	CP-4-26	CP-2-31	CP-2-32	CP-2-32	CP-2-31	CP-4-26	CP-2-28	
	Green	Purple	Gray	White	White	Gray	Purple	Green	

Notes:

1. The same isolators are used when the chiller is supplied with the optional copper finned condenser coils.
2. The -2- or -4- indicates that two or four springs are used in the isolator.

Table 4, Spring Vibration Isolators, AGS 340 – 475, Part Numbers and Spring Colors

Model	Mounting Location (See Footprint Drawings Figure 18 or Figure 19)					
	M1	M2	M3	M4	M5	M6
AGS340	CP-2-28	CP-4-26	CP-2-28	CP-4-26	CP-4-26	CP-2-28
	Green	Purple	Green	Purple	Purple	Green
AGS370	CP-2-28	CP-4-26	CP-2-31	CP-4-26	CP-4-26	CP-2-31
	Green	Purple	Gray	Purple	Purple	Gray
AGS400	CP-2-28	CP-4-26	CP-2-31	CP-4-26	CP-4-27	CP-2-31
	Green	Purple	Gray	Purple	Orange	Gray
AGS420	CP-2-31	CP-4-26	CP-2-31	CP-4-27	CP-4-27	CP-2-31
	Gray	Purple	Gray	Orange	Orange	Gray
AGS440	CP-2-31	CP-4-26	CP-4-26	CP-4-27	CP-4-27	CP-4-26
	Gray	Purple	Purple	Orange	Orange	Purple
AGS450	CP-2-31	CP-4-26	CP-4-26	CP-4-27	CP-4-27	CP-4-26
	Gray	Purple	Purple	Orange	Orange	Purple
AGS475	CP-2-31	CP-4-26	CP-4-26	CP-4-27	CP-4-27	CP-4-26
	Gray	Purple	Purple	Orange	Orange	Purple

Continued

Model	Mounting Location (Table Continued)						Kit Number
	M7	M8	M9	M10	M11	M12	
AGS340	CP-4-26	CP-2-28	CP-2-31	CP-2-27	CP-2-27	CP-2-27	350348104
	Purple	Green	Gray	Orange	Orange	Orange	
AGS370	CP-4-26	CP-2-28	CP-2-31	CP-2-28	CP-2-31	CP-2-28	350348105
	Purple	Green	Gray	Green	Gray	Green	
AGS400	CP-4-26	CP-2-31	CP-2-31	CP-2-28	CP-2-31	CP-2-28	350348106
	Purple	Gray	Gray	Green	Gray	Green	
AGS420	CP-4-26	CP-2-31	CP-2-31	CP-2-28	CP-2-31	CP-2-28	350348107
	Purple	Gray	Gray	Green	Gray	Green	
AGS440	CP-4-26	CP-2-31	CP-2-31	CP-2-28	CP-2-31	CP-2-28	350348108
	Purple	Gray	Gray	Green	Gray	Green	
AGS450	CP-4-26	CP-2-31	CP-2-31	CP-2-28	CP-2-31	CP-2-28	
	Purple	Gray	Gray	Green	Gray	Green	
AGS475	CP-4-26	CP-2-31	CP-2-31	CP-2-28	CP-2-31	CP-2-28	
	Purple	Gray	Gray	Green	Gray	Green	

Notes:

1. The same isolators are used when the chiller is supplied with the optional copper finned condenser coils.
2. The -2- or -4- indicates that two or four springs are used in the isolator.

Table 5, Neoprene-in-Shear Isolators, AGS 230 – 320, Part Numbers

Model	Mounting Location (See Footprint Drawings Figure 16 or Figure 17)								Kit Number
	M1	M2	M3	M4	M5	M6	M7	M8	
AGS230	4-RED	4-RED	4-RED	4-RED	4-RED	4-RED	4-RED	4-RED	350348201
AGS250	4-RED	4-RED	4-RED	4-RED	4-GREEN	4-RED	4-RED	4-RED	350348202
AGS270	4-RED	4-RED	4-RED	4-GREEN	4-GREEN	4-RED	4-RED	4-RED	350348203
AGS300	4-RED	4-RED	4-RED	4-GREEN	4-GREEN	4-RED	4-RED	4-RED	
AGS320	4-RED	4-RED	4-RED	4-GREEN	4-GREEN	4-RED	4-RED	4-RED	

Note: The same isolators are used when the chiller is supplied with the optional copper finned condenser coils.

Table 6, Neoprene-in-Shear Isolators, AGS 340 – 475, Part Numbers

Model	Mounting Location (See Footprint Drawings Figure 18 or Figure 19)					
	M1	M2	M3	M4	M5	M6
AGS340	4-RED	4-RED	4-RED	4-RED	4-RED	4-RED
AGS370	4-RED	4-GREEN	4-RED	4-GREEN	4-GREEN	4-RED
AGS400	4-RED	4-GREEN	4-RED	4-GREEN	4-GREEN	4-RED
AGS420	4-RED	4-GREEN	4-RED	4-GREEN	4-GREEN	4-RED
AGS440	4-RED	4-GREEN	4-RED	4-GREEN	4-GREEN	4-RED
AGS450	4-RED	4-GREEN	4-RED	4-GREEN	4-GREEN	4-RED
AGS475	4-RED	4-GREEN	4-RED	4-GREEN	4-GREEN	4-RED

Continued

Model	Mounting Location (Table Continued)						Kit Number
	M7	M8	M9	M10	M11	M12	
AGS340	4-RED	4-RED	4-RED	4-RED	4-RED	4-RED	350348204
AGS370	4-GREEN	4-RED	4-RED	4-RED	4-RED	4-RED	350348205
AGS400	4-GREEN	4-RED	4-RED	4-RED	4-RED	4-RED	
AGS420	4-GREEN	4-RED	4-RED	4-RED	4-RED	4-RED	
AGS440	4-GREEN	4-RED	4-RED	4-RED	4-RED	4-RED	
AGS450	4-GREEN	4-RED	4-RED	4-RED	4-RED	4-RED	
AGS475	4-GREEN	4-RED	4-RED	4-RED	4-RED	4-RED	

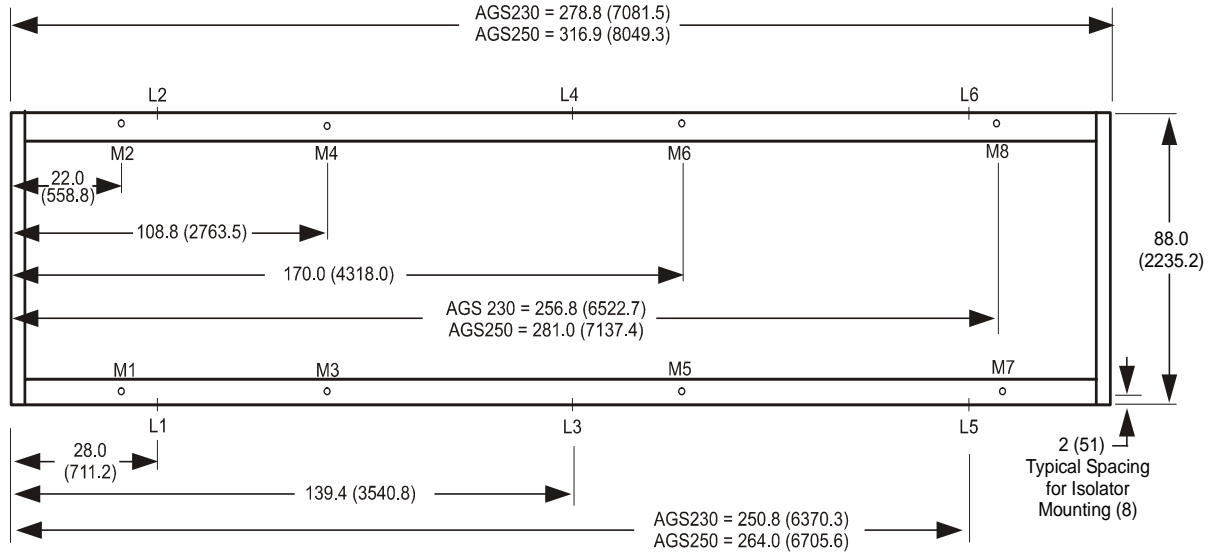
Note: The same isolators are used when the chiller is supplied with the optional copper finned condenser coils.

The unit should be initially installed on shims or blocks at the illustrated "free height" of the isolator that is six inches for the McQuay isolators shown. When all piping, wiring, flushing, charging, etc. is complete, the springs should be adjusted upward to load them and to provide clearance to free the blocks, which are then removed.

Installation of spring isolators requires flexible pipe connections and at least three feet of conduit flex tie-ins. Piping and conduit should be supported independently from the unit so as not to stress connections.

Lifting and Mounting Weights

Figure 16, AGS 230B – AGS 250B Lifting and Mounting Locations



NOTE: For orientation, in Figure 16 and Figure 17, the evaporator connections point left.

Figure 17, AGS 270B - AGS 320B Lifting and Mounting Locations

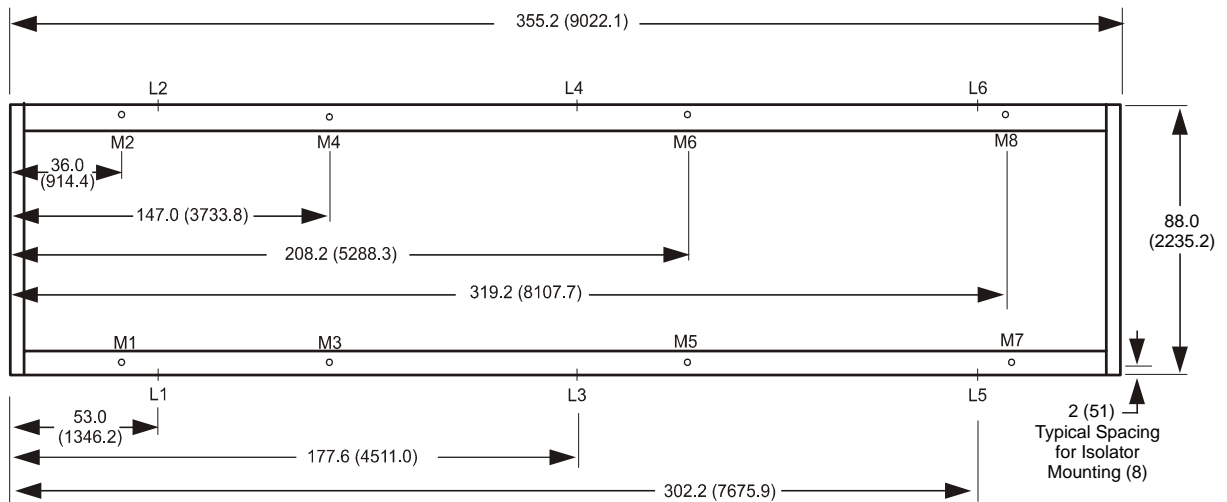


Table 7, AGS 230B - AGS 320B Lifting and Mounting Weights (Aluminum Fin)

AGS Model		Lifting Weight for Each Point lb. (kg)						Mounting Loads for Each Point lb. (kg)							
		L1	L2	L3	L4	L5	L6	M1	M2	M3	M4	M5	M6	M7	M8
230B	Lbs.	2183	3043	2563	2563	3043	2183	1683	2325	1681	2322	2322	1681	2325	1683
	(kg)	991	1382	1164	1164	1382	991	764	1055	763	1054	1054	763	1055	764
250B	Lbs.	2183	3043	2700	2704	3374	2509	1683	2325	1681	2322	2693	2018	2421	1814
	(kg)	991	1382	1226	1228	1532	1139	764	1055	763	1054	1223	916	1099	824
270B	Lbs.	2509	3374	2841	2841	3374	2509	1814	2421	2018	2693	2693	2018	2421	1814
	(kg)	1139	1532	1290	1290	1532	1139	824	1099	916	1223	1223	916	1099	824
300B	Lbs.	2520	3383	2871	2871	3383	2520	1821	2425	2043	2721	2721	2043	2425	1821
	(kg)	1144	1536	1304	1304	1536	1144	827	1101	928	1235	1235	928	1101	827
320B	Lbs.	2550	3407	2956	2956	3407	2550	1838	2435	2111	2797	2797	2111	2435	1838
	(kg)	1158	1547	1342	1342	1547	1158	834	1106	958	1270	1270	958	1106	834

NOTES:

1. Lifting tabs with 2 ½ in. (63.5 mm) holes at location "L" on side of base rail.
2. 1 in. (25.4 mm) mounting holes at location "M" on bottom of base rails.

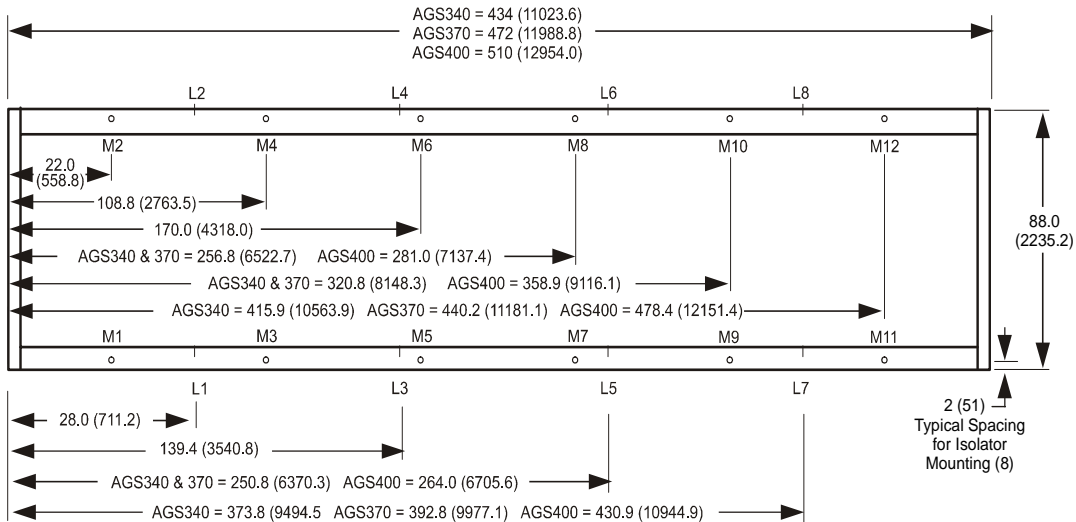
Table 8, AGS 230B - AGS 320B Lifting and Mounting Weights (Copper Fin)

AGS Model		Lifting Weight for Each Point lb. (kg)						Mounting Loads for Each Point lb. (kg)							
		L1	L2	L3	L4	L5	L6	M1	M2	M3	M4	M5	M6	M7	M8
230B	Lbs.	2499	3359	2879	2879	3359	2499	1920	2562	1918	2559	2559	1918	2562	1920
	(kg)	1135	1525	1307	1307	1525	1135	872	1163	871	1162	1162	871	1163	872
250B	Lbs.	2552	3412	3069	3073	3743	2878	1960	2602	1958	2599	2970	2295	2698	2091
	(kg)	1158	1549	1393	1395	1699	1306	890	1181	889	1180	1348	1042	1225	949
270B	Lbs.	2930	3795	3262	3262	3795	2930	2130	2737	2334	3009	3009	2334	2737	2130
	(kg)	1330	1723	1481	1481	1723	1330	967	1243	1060	1366	1366	1060	1243	967
300B	Lbs.	2941	3804	3292	3292	3804	2941	2137	2741	2359	3037	3037	2359	2741	2137
	(kg)	1335	1727	1495	1495	1727	1335	970	1244	1071	1379	1379	1071	1244	970
320B	Lbs.	2971	3828	3377	3377	3828	2971	2154	2751	2427	3113	3113	2427	2751	2154
	(kg)	1349	1738	1533	1533	1738	1349	978	1249	1102	1413	1413	1102	1249	978

NOTES:

1. Lifting tabs with 2½ in. (63.5 mm) holes at location "L" on side of base rail.
2. 1 in. (25.4 mm) mounting holes at location "M" on bottom of base rails.

Figure 18, AGS 340B – AGS 400B Lifting and Mounting Locations



NOTE: For orientation, in Figure 18 and Figure 19, the evaporator connections point left.

Figure 19, AGS 420B - AGS 475B Lifting and Mounting Locations

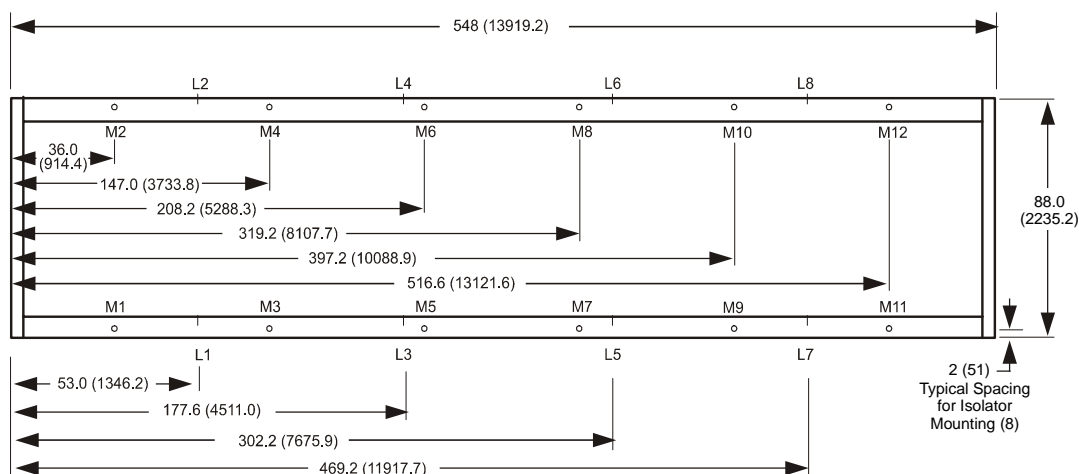


Table 9, AGS 340B - AGS 475B Lifting Weights (Aluminum Fin)

AGS Model		Lifting Weight for Each Point lb. (kg)							
		L1	L2	L3	L4	L5	L6	L7	L8
340B	lbs	2312	3173	2681	2681	3352	2473	3192	2880
	(kg)	1050	1441	1217	1217	1522	1123	1449	1307
370B	lbs	2449	3296	2951	2951	3617	2742	3519	3216
	(kg)	1112	1496	1340	1340	1642	1245	1597	1460
400B	lbs	2449	3296	3119	3117	3917	3044	3519	3216
	(kg)	1112	1496	1416	1415	1778	1382	1597	1460
420B	lbs	2751	3596	3285	3285	3917	3044	3519	3216
	(kg)	1249	1633	1491	1491	1778	1382	1597	1460
440B	lbs	2783	3624	3361	3361	3945	3076	3519	3216
	(kg)	1263	1645	1526	1526	1791	1396	1597	1460
450B	lbs	2783	3624	3361	3361	3945	3076	3519	3216
	(kg)	1263	1645	1526	1526	1791	1396	1597	1460
475B	lbs	2783	3624	3361	3361	3945	3076	3519	3216
	(kg)	1263	1645	1526	1526	1791	1396	1597	1460

Table 10, AGS 340B - AGS 475B Lifting Weights (Copper Fin)

AGS Model		Lifting Weight for Each Point lb. (kg)							
		L1	L2	L3	L4	L5	L6	L7	L8
340B	lbs	2668	3529	3037	3037	3708	2829	3548	3236
	(kg)	1211	1602	1379	1379	1683	1284	1611	1469
370B	lbs	2844	3691	3346	3346	4012	3137	3914	3611
	(kg)	1291	1676	1519	1519	1821	1424	1777	1639
400B	lbs	2884	3731	3554	3552	4352	3479	3954	3651
	(kg)	1309	1694	1613	1612	1976	1579	1795	1657
420B	lbs	3225	4070	3759	3759	4391	3518	3993	3690
	(kg)	1464	1848	1707	1707	1994	1597	1813	1675
440B	lbs	3257	4098	3835	3835	4419	3550	3993	3690
	(kg)	1479	1860	1741	1741	2006	1612	1813	1675
450B	lbs	3257	4098	3835	3835	4419	3550	3993	3690
	(kg)	1479	1860	1741	1741	2006	1612	1813	1675
475B	lbs	3257	4098	3835	3835	4419	3550	3993	3690
	(kg)	1479	1860	1741	1741	2006	1612	1813	1675

Table 11, AGS 340B - AGS 475B Mounting Weights (Aluminum Fin)

AGS Model		Mounting Loads for Each Point lb. (kg)											
		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
340B	lbs	1798	2442	1787	2426	2426	1787	2442	1798	1726	1557	1645	1484
	kg	816	1109	811	1101	1101	811	1109	816	784	707	747	674
370B	lbs	1885	2511	1981	2638	2638	1981	2511	1885	1973	1803	1867	1706
	kg	856	1140	899	1198	1198	899	1140	856	896	819	847	775
400B	lbs	1885	2511	1981	2638	3055	2357	2562	1977	1973	1803	1867	1706
	kg	856	1140	899	1198	1387	1070	1163	897	896	819	847	775
420B	lbs	1977	2562	2357	3055	3055	2357	2562	1977	1973	1803	1867	1706
	kg	897	1163	1070	1387	1387	1070	1163	897	896	819	847	775
440B	lbs	1999	2579	2425	3128	3128	2425	2579	1999	1973	1803	1867	1706
	kg	908	1171	1101	1420	1420	1101	1171	908	896	819	847	775
450B	lbs	1999	2579	2425	3128	3128	2425	2579	1999	1973	1803	1867	1706
	kg	908	1171	1101	1420	1420	1101	1171	908	896	819	847	775
475B	lbs	1999	2579	2425	3128	3128	2425	2579	1999	1973	1803	1867	1706
	kg	908	1171	1101	1420	1420	1101	1171	908	896	819	847	775

Table 12, AGS 340B - AGS 475B Mounting Weights (Copper Fin)

AGS Model		Mounting Loads for Each Point lb. (kg)											
		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
340B	lbs	2035	2679	2024	2663	2663	2024	2679	2035	1963	1794	1882	1721
	kg	924	1216	919	1209	1209	919	1216	924	891	814	854	781
370B	lbs	2148	2774	2244	2901	2901	2244	2774	2148	2236	2066	2130	1969
	kg	975	1260	1019	1317	1317	1019	1260	975	1015	938	967	894
400B	lbs	2175	2801	2271	2928	3345	2647	2852	2267	2263	2093	2157	1996
	kg	987	1272	1031	1329	1518	1202	1295	1029	1027	950	979	906
420B	lbs	2293	2878	2673	3371	3371	2673	2878	2293	2289	2119	2183	2022
	kg	1041	1307	1214	1530	1530	1214	1307	1041	1039	962	991	918
440B	lbs	2315	2895	2741	3444	3444	2741	2895	2315	2289	2119	2183	2022
	kg	1051	1314	1244	1564	1564	1244	1314	1051	1039	962	991	918
450B	lbs	2315	2895	2741	3444	3444	2741	2895	2315	2289	2119	2183	2022
	kg	1051	1314	1244	1564	1564	1244	1314	1051	1039	962	991	918
475B	lbs	2315	2895	2741	3444	3444	2741	2895	2315	2289	2119	2183	2022
	kg	1051	1314	1244	1564	1564	1244	1314	1051	1039	962	991	918

Chilled Water Pump

It is required that the starter(s) for the chilled water pump be wired to and controlled by the chiller's microprocessor. The controller will energize the pump whenever at least one circuit on the chiller is *enabled* to run, whether there is a call for cooling or not. The pump will also be energized when the controller senses a near-freezing temperature at the chiller outlet sensor to assist in freeze protection. Connection points are shown in Figure 27 on page 40.

Water Piping

Due to the variety of piping practices, it is advisable to follow the recommendations of local authorities. They can supply the installer with the proper building and safety codes required for a safe and proper installation.

NOTE: Chilled water piping must enter and exit the unit platform between the base rail and the bottom of the condenser coil in the approximately 30-inch width shown on Figure 23 and Figure 24.

The piping should be designed with a minimum number of bends and changes in elevation to keep system cost down and performance up. It should contain:

1. Vibration eliminators to reduce vibration and noise transmission to the building.
2. Shutoff valves to isolate the unit from the piping system during unit servicing.
3. Manual or automatic air vent valves at the high points of the system and drains at the low parts in the system. If the evaporator is the highest point in the piping system, it must be equipped with an air vent.
4. Some means of maintaining adequate system water pressure (i.e., expansion tank or regulating valve).
5. Water temperature and pressure indicators located at the unit to aid in unit servicing.
6. A strainer to remove foreign matter from the water before it enters the pump. The strainer should be placed far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump life and help maintain high system performance levels.

NOTE: A 40-mesh strainer must also be placed in the supply water line just prior to the inlet of the evaporator. This will aid in preventing foreign material from entering the evaporator and causing damage or decreasing its performance. Care must also be exercised if welding pipe or flanges to the evaporator connections to prevent any weld slag from entering the vessel.

7. Protected water piping to the unit to prevent freeze-up if below freezing temperatures are expected. See page 21 for further information on freeze protection.
-



CAUTION

If a separate disconnect is used for the 115V supply to the unit, it should power the entire control circuit, not just the evaporator heaters. It should be clearly marked so that it is not accidentally shut off during cold seasons. Freeze damage to the evaporator could result. If the evaporator is drained for winter freeze protection, the heaters must be de-energized to prevent heater burnout.

8. If the unit is used as a replacement chiller on a previously existing piping system, flush the system thoroughly prior to unit installation. Then regular chilled water analysis and chemical water treatment is recommended at equipment start-up.
9. In the event glycol is added to the water system as a late addition for freeze protection, recognize that the refrigerant suction pressure will be lower, cooling performance less, and water side pressure drop greater. If the percentage of glycol is large, or if propylene is employed in lieu of ethylene glycol, the added pressure drop and loss of performance could be substantial.
10. For ice making or low temperature glycol operation, the freezestat pressure value will need to be checked and probably lowered. The freezestat setting can be manually changed through the MicroTech II controller.

Make a preliminary leak check prior to insulating the water piping and filling the system.

Include a vapor barrier on piping insulation to prevent moisture condensation and possible damage to the building structure. It is important to have the vapor barrier on the outside of the insulation to prevent condensation within the insulation on the cold surface of the pipe.

System Water Volume

It is important to have adequate water volume in the system to provide an opportunity for the chiller to sense a load change, adjust to the change and stabilize. As the expected load change becomes more rapid, a greater water volume is needed. The system water volume is the total amount of water in the evaporator, air handling products and associated piping. If the water volume is too low, operational problems can occur including rapid compressor cycling, rapid loading and unloading of compressors, erratic refrigerant flow in the chiller, improper motor cooling, shortened equipment life and other undesirable consequences.

For normal comfort cooling applications where the cooling load changes relatively slowly, we recommend a minimum system volume of three minutes times the flow rate (gpm). For example, if the design chiller flow rate is 800 gpm, we recommend a minimum system volume of 2400 gallons (800 gpm x 3 minutes).

For process applications where the cooling load can change rapidly, additional system water volume is needed. A process example would be a quenching tank. The load would be very stable until the hot material is immersed in the water tank. Then, the load would increase drastically. For this type of application, system volume will have to be increased.

Since there are many other factors that can influence performance, systems can successfully operate below these suggestions. However, as the water volume decreases below these suggestions, the possibility of problems increases.

Variable Speed Pumping

Variable water flow involves changing the water flow through the evaporator as the load changes. McQuay chillers are designed for this duty, provided that the rate of change in water flow is slow and the minimum and maximum flow rates for the vessel are not exceeded.

The recommended maximum change in water flow is 10 percent of the change per minute.

The water flow through the vessel must remain between the minimum and maximum values listed on page 26. If flow drops below the minimum allowable, large reductions in heat transfer can occur. If the flow exceeds the maximum rate, excessive pressure drop and tube erosion can occur.

Evaporator Freeze Protection

Flooded evaporators are popular with chiller manufacturers because of their inherent high efficiency. Care must be exercised in the equipment design and in the operation of these evaporators to prevent freezing between 32°F and -20°F.

For protection down to 0°F (-18°C), the AGS chillers are equipped with thermostatically controlled evaporator heaters that help protect against freeze-up provided the chiller goes through its normal pumpdown cycle. Several occurrences can prevent this normal pumpdown from happening:

1. A power failure will prevent pumpdown and there is a potential for freezing outdoor equipment in systems using 100 percent water as the chilled fluid.
2. Unit shutdown due to a fault will cause immediate compressor shutdown without the pumpdown cycle. This situation can be remedied by correcting the fault, restarting the unit, and allowing it to go through its normal shutdown pumpdown.

NOTE: The heaters come from the factory connected to the control power circuit. If desired, the 3 KVA control transformer can be unwired and a field 115-volt power source wired to terminals TB1-1 and TB1-2 in the control panel for circuit #1 (do not wire directly to the heater). If this is done, the disconnect switch should be clearly marked to avoid accidental deactivation of the heater during freezing temperatures. Exposed chilled water piping also requires protection.

It is required that the chilled water pump's starter be wired to, and controlled by, the chiller's microprocessor. The controller will energize the pump whenever at least one circuit on the chiller is *enabled* to run, whether there is a call for cooling or not. The pump will also be energized when the controller senses a near-freezing temperature at the chiller outlet sensor to assist in cold weather freeze protection. Connection points are shown in Figure 27 on page 40.

For additional protection to -20°F (-29°C) and to protect against the consequences described above, it is recommended that at least one of the following procedures be used during periods of sub-freezing temperatures:

1. Addition of a concentration of a glycol anti-freeze with a freeze point 10 degrees F (5.5 degrees C) below the lowest expected temperature. This will result in decreased capacity and increased pressure drop.

Note: Do not use automotive grade antifreezes as they contain inhibitors harmful to chilled water systems. Only use glycols specifically designated for use in building cooling systems.

2. Draining the water from outdoor equipment and piping and blowing the chiller tubes dry from the chiller. Do not energize the chiller heater when water is drained from the vessel.



CAUTION

If fluid is absent from the evaporator, the evaporator heater must be de-energized to avoid burning out the heater and causing damage from the high temperatures.

3. Providing operation of the chilled water pump, circulating water through the chilled water system and through the evaporator. The chiller microprocessor will automatically start up the pump if so wired.

Table 13, Freeze Protection

Temperature °F (°C)	Percent Volume Glycol Concentration Required			
	For Freeze Protection		For Burst Protection	
	Ethylene Glycol	Propylene Glycol	Ethylene Glycol	Propylene Glycol
20 (6.7)	16	18	11	12
10 (-12.2)	25	29	17	20
0 (-17.8)	33	36	22	24
-10 (-23.3)	39	42	26	28
-20 (-28.9)	44	46	30	30
-30 (-34.4)	48	50	30	33
-40 (-40.0)	52	54	30	35
-50 (-45.6)	56	57	30	35
-60 (-51.1)	60	60	30	35

Notes:

1. These figures are examples only and cannot be appropriate to every situation. Generally, for an extended margin of protection, select a temperature at least 10°F lower than the expected lowest ambient temperature. Inhibitor levels should be adjusted for solutions less than 25% glycol.
2. Glycol of less than 25% concentration is not recommended because of the potential for bacterial growth and subsequent loss of heat transfer efficiency, or add inhibitors.

Operating Limits:

Maximum standby ambient temperature, 130°F (55°C)

Maximum operating ambient temperature, 115°F (46°C), or 125°F (52°C) with optional high ambient package

Minimum operating ambient temperature (standard), 35°F (2°C)

Minimum operating ambient temperature (optional low-ambient control), 0°F (-18°C)

Leaving chilled water temperature, 40°F to 50°F (4.4°C to 10°C)

Leaving chilled fluid temperature (with anti-freeze), 20°F to 50°F (7°C to 10°C)

Operating Delta-T range, 6 degrees F to 16 degrees F (3.3 C to 8.8 C)

Maximum operating inlet fluid temperature, 66°F (19°C)

Maximum startup inlet fluid temperature, 90°F (32°C)

Maximum non-operating inlet fluid temperature, 100°F (38°C)

NOTE: Contact the local McQuay sales office for operation outside of these limits.

Flow Switch

A water flow switch must be mounted in the leaving chilled water line to prove that there is adequate water flow to the evaporator before the unit can start. It also serves to shut down the unit in the event that water flow is interrupted in order to guard against evaporator freeze-up.

A flow switch is available from McQuay under ordering number 017503300. It is a paddle-type switch and adaptable to any pipe size from 1" (25mm) to 8" (203mm) nominal.

Certain minimum flow rates are required to close the switch and are listed in Table 14. Installation should be as shown in Figure 20.

Electrical connections in the unit control center should be made at terminals 60 and 67. The normally open contacts of the flow switch should be wired between these two terminals. Flow switch contact quality must be suitable for 24 VAC, low current (16ma). Flow switch wire must be in separate conduit from any high voltage conductors (115 VAC and higher) and have an insulation rating of 600 volts.

Figure 20, Flow Switch

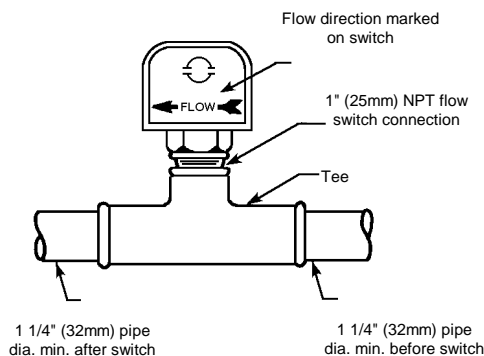
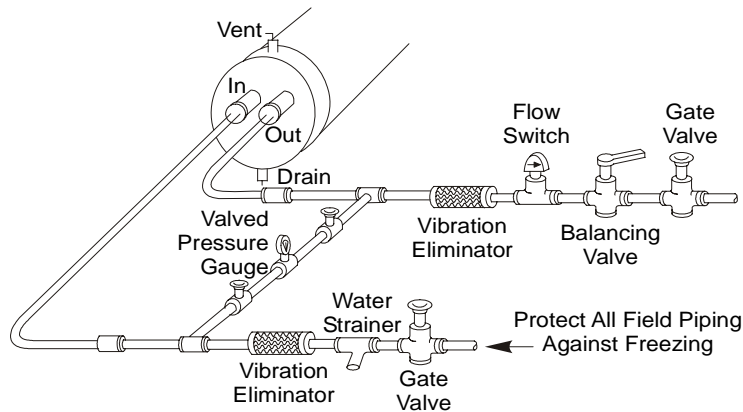


Table 14, Switch Minimum Flow Rates

NOMINAL PIPE SIZE INCHES (MM)	MINIMUM REQUIRED FLOW TO ACTIVATE SWITCH GPM (LPS)
5 (127)	58.7 (3.7)
6 (152)	79.2 (5.0)
8 (203)	140 (8.8)

Note: Water pressure differential switches are not recommended for outdoor applications.

Figure 21, Typical Field Water Piping



Notes:

1. Connections for vent and drain fittings are located on the top and bottom of both evaporator water heads.
2. Piping must be supported to avoid putting strain on the evaporator nozzles.

Water Connections

Water piping to the evaporator must be brought out through the side of the unit between the vertical supports. The dimensional drawings on page 30 and 31 give the necessary dimensions and locations for all piping connections. Evaporator piping connections face toward the left side of the unit when looking at control panel #3.

Refrigerant Charge

All units are designed for use with R-134a and are shipped with a full operating charge. The operating charge for each unit is shown in the Physical Data Tables beginning on page 27.

Glycol Solutions

When using glycol anti-freeze solutions the chiller's capacity, glycol solution flow rate, and pressure drop through the evaporator can be calculated using the following formulas and tables.

Note: The following procedure does not specify the type of glycol. Use the derate factors found in Table 15 for corrections when using ethylene glycol and those in Table 16 for propylene glycol.

1. **Capacity** - Cooling capacity is reduced from that with plain water. To find the reduced value, multiply the chiller's water system tonnage by the capacity (Cap) correction factor to find the chiller's capacity when using glycol.

2. **Flow** - To determine flow (or delta-T) knowing delta-T (or flow) and capacity:

$$GPM = \frac{(24)(\text{tons})(\text{flow factor})}{\text{Delta-T}} \quad (\text{Water only, use Flow correction for glycols})$$

3. **Pressure drop** - To determine pressure drop through the evaporator when using glycol, enter the water pressure drop curve at the water flow rate. Multiply the water pressure drop found there by the "PD" factor to obtain corrected glycol pressure drop.
4. **Power** - To determine glycol system kW, multiply the water system kW by the factor designated "Power".

Test coolant with a clean, accurate glycol solution hydrometer (similar to that found in service stations) to determine the freezing point. Obtain percent glycol from the freezing point table below. On glycol applications the supplier normally recommends that a minimum of 20% solution by weight be used for protection against corrosion.



CAUTION

Do not use automotive grade antifreeze. Industrial grade glycols must be used.

Automotive antifreeze contains inhibitors that will cause plating on the copper tubes within the chiller evaporator. The type and handling of glycol used must be consistent with local codes.

Table 15, Ethylene Glycol Factors

% E.G	Freeze Point		Cap.	Power	Flow	PD
	°F	°C				
10	26	-3.3	0.994	0.998	1.036	1.104
20	18	-7.8	0.979	0.990	1.060	1.256
30	7	-13.9	0.964	0.983	1.092	1.424
40	-7	-21.7	0.943	0.973	1.132	1.664
50	-28	-33.3	0.920	0.963	1.182	1.944

Table 16, Propylene Glycol Factors

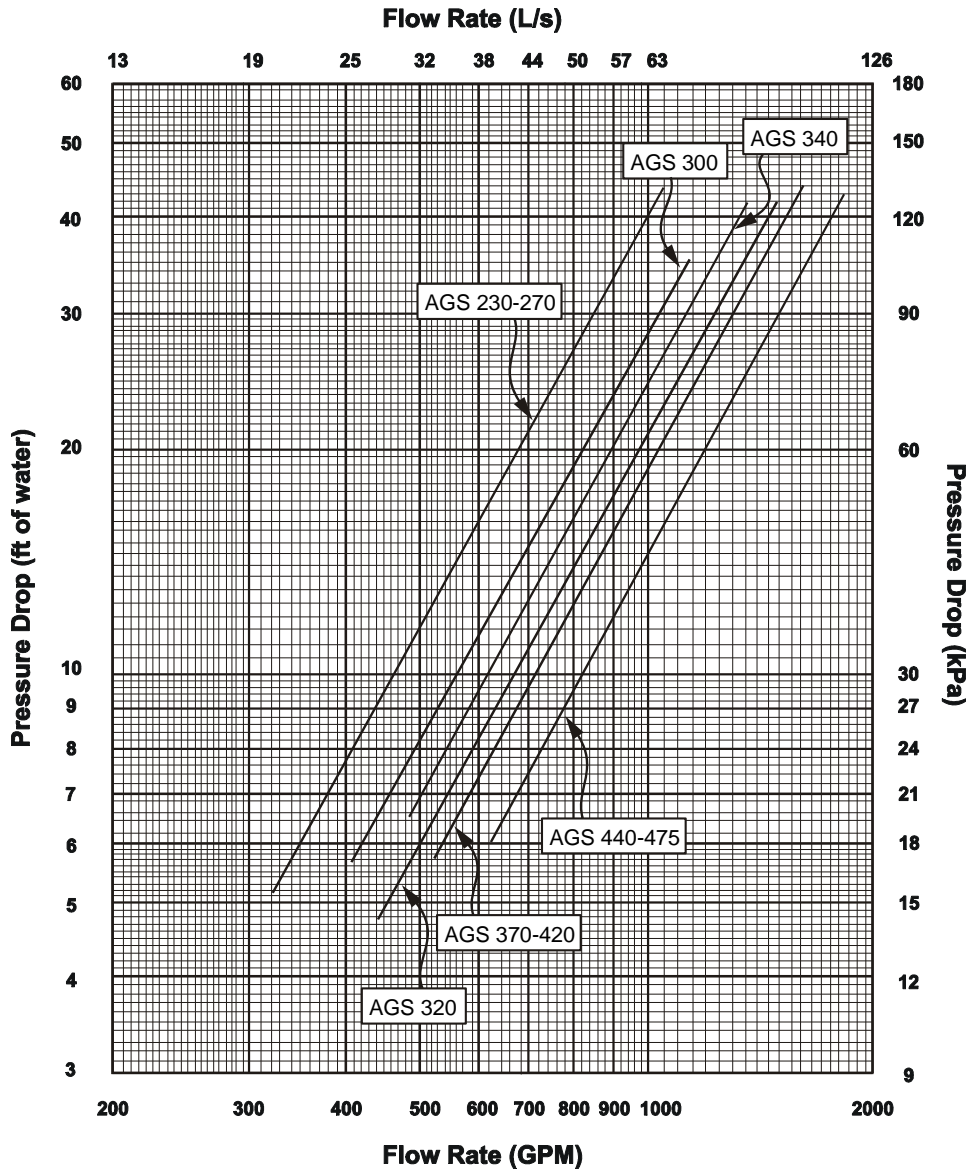
% P.G	Freeze Point		Cap.	Power	Flow	PD
	°F	°C				
10	26	-3.3	0.985	0.993	1.017	1.120
20	19	-7.2	0.964	0.983	1.032	1.272
30	9	-12.8	0.932	0.969	1.056	1.496
40	-5	-20.6	0.889	0.948	1.092	1.792
50	-27	-32.8	0.846	0.929	1.139	2.128

Water Flow and Pressure Drop

The chilled water flow through the evaporator should be adjusted to meet specified conditions. The flow rates must fall between the minimum and maximum values shown in table on the following page. Flow rates below the minimum values shown will result in laminar flow that will reduce efficiency, cause erratic operation of the electronic expansion valve and could cause low temperature cutouts. On the other hand flow rates exceeding the maximum values shown can cause erosion on the evaporator water connections and tubes.

Measure the chilled water pressure drop through the evaporator at field installed pressure taps. It is important not to include valve or strainer pressure drop in these readings.

Figure 22, Evaporator Pressure Drops



Minimum/Nominal/Maximum Flow Rates

AGS Unit Size	Minimum Flow		Nominal Flow		Maximum Flow	
	Flow	ΔP	Flow	ΔP	Flow	ΔP
	gpm	ft.	gpm	ft.	gpm	ft.
230B	330	5.3	529	12.8	882	32.0
250B	365	6.5	585	15.3	975	37.5
270B	401	7.8	642	18.2	1070	44.0
300B	424	6.1	679	14.2	1132	35.2
320B	451	4.9	722	11.5	1203	39.0
340B	501	7.0	801	16.0	1336	42.0
370B	540	6.1	864	14.4	1440	36.0
400B	576	6.8	922	16.0	1537	40.0
420B	613	7.5	981	18.2	1635	44.0
440B	640	6.4	1025	15.2	1708	38.0
450B	660	6.7	1057	16.4	1762	41.0
475B	680	7.1	1089	17.0	1815	43.0

Physical Data

Table 17, Physical Data, AGS 230B – AGS 270B

DATA	230B		250B		270B	
	Ckt 1	Ckt 2	Ckt 1	Ckt 2	Ckt 1	Ckt 2
BASIC DATA						
Cap. @ ARI Conditions, tons (kW)	220.5 (774)		243.9 (856)		267.5 (939)	
Unit Operating Charge lbs (kg)	298 (135)	298 (135)	298 (135)	321 (145)	321 (145)	321 (145)
Cabinet Dimensions L x W x H, in. (mm)	278 x 88 x 100 (7087 x 2235 x 2550)		317 x 88 x 100 (8052 x 2235 x 2550)		355.x 88 x 100 (9017 x 2235 x 2550)	
Unit Operating Weight, lbs. (kg)	16022 (7272)		16957 (7698)		17892 (8124)	
Unit Shipping Weight, lbs (kg)	15578 (7074)		16513 (7498)		17448 (7922)	
COMPRESSORS, SCREW, SEMI-HERMETIC						
Nominal Capacity, tons (kW)	100 (350)	100 (350)	100 (350)	125 (437)	125 (437)	125 (437)
CONDENSERS, HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER						
Coil Face Area, ft ² . (m ²)	159 (14.8)	159 (14.8)	159 (14.8)	213 (19.8)	213 (19.8)	213 (19.8)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3
CONDENSER FANS, DIRECT DRIVE PROPELLER TYPE						
No. of Fans -- Fan Dia., in. (mm)	12 – 30 (762)		14 – 30 (762)		16 – 30 (762)	
No. of Motors -- hp (kW)	12 – 2 (1.5)		14 – 2 (1.5)		16 – 2 (1.5)	
Fan & Motor RPM, 60Hz	1140		1140		1140	
60 Hz Fan Tip Speed, fpm	8954		8954		8954	
60 Hz Total Unit Airflow, ft ³ /min	129,600		151,200		172,800	
EVAPORATOR, FLOODED SHELL AND TUBE						
Shell Dia.-Tube Length in.(mm) - in. (mm)	24 (610) – 96 (2438)		24 (610) – 96 (2438)		24 (610) – 96 (2438)	
Evaporator R-134a Charge lbs (kg)	182 (37)	182 (37)	182 (37)	182 (37)	182 (37)	182 (37)
Water Volume, gallons (liters)	48 (182)		48 (182)		48 (182)	
Max. Water Pressure, psi (kPa)	150 (1034)		150 (1034)		150 (1034)	
Max. Refrigerant Press., psi (kPa)	200 (1379)		200 (1379)		200 (1379)	

NOTE: Weights shown are for aluminum fin coils. Add 158 lbs. (72 kg) per fan to operating or shipping weights for copper fins.

Table 18, Physical Data, AGS 300B – AGS 320B

DATA	300B		320B	
	Ckt 1	Ckt 2	Ckt 1	Ckt 2
BASIC DATA				
Unit Cap. @ ARI, tons (kW)	283.1 (994)		300.9 (1056)	
Unit Operating Charge lbs (kg)	335 (152)	335 (152)	360 (163)	360 (163)
Cabinet Dimensions L x W x H, in. (mm)	355 x 88 x 100 (9017 x 2235 x 2550)		355 x 88 x 100 (9017 x 2235 x 2550)	
Unit Operating Weight, lbs. (kg)	18020 (8182)		18362 (8336)	
Unit Shipping Weight, lbs (kg)	17548 (7968)		17826 (8094)	
COMPRESSORS, SCREW, SEMI-HERMETIC				
Nominal Capacity, tons (kW)	125 (437)	150 (525)	150 (525)	150 (525)
CONDENSERS, HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER				
Coil Face Area, ft ² . (m ²)	213 (19.8)	213 (19.8)	213 (19.8)	213 (19.8)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3
CONDENSER FANS, DIRECT DRIVE PROPELLER TYPE				
No. of Fans -- Fan Dia., in. (mm)	16 – 30 (762)		16 – 30 (762)	
No. of Motors -- hp (kW)	16 – 2 (1.5)		16 – 2 (1.5)	
Fan & Motor RPM, 60Hz	1140		1140	
60 Hz Fan Tip Speed, fpm	8954		8954	
60 Hz Total Unit Airflow, ft ³ /min	172,800		172,800	
EVAPORATOR, FLOODED SHELL AND TUBE				
Shell Dia.-Tube Length in.(mm) - in. (mm)	24 (610) – 96 (2438)		26 (660) – 96 (2438)	
Evaporator R-134a Charge lbs (kg)	196 (89)	196 (89)	221 (100)	221 (100)
Water Volume, gallons (liters)	51 (195)		59 (221)	
Max. Water Pressure, psi (kPa)	150 (1034)		150 (1034)	
Max. Refrigerant Press., psi (kPa)	200 (1379)		200 (1379)	

NOTE: Weights shown are for aluminum fin coils. Add 158 lbs. (72 kg) per fan to operating or shipping weights for copper fins.

Table 19, Physical Data, AGS 340B – AGS 400B

DATA	AGS MODEL NUMBER								
	340B			370B			400B		
	Ckt. 1	Ckt. 2	Ckt. 3	Ckt. 1	Ckt. 2	Ckt. 3	Ckt. 1	Ckt. 2	Ckt. 3
BASIC DATA									
Unit Cap. @ ARI, tons (kW)	334.1 (1173)			360.0 (1264)			384.3 (1349)		
Unit Operating Charge, lbs (kg)	285 (129)	285 (129)	285 (129)	312 (141)	312 (141)	312 (141)	312 (141)	335 (152)	335 (152)
Cabinet Dim., L x W x H, in. (mm)	434 x 88 x 100 (11024 x 2235 x 2550)			472 x 88 x 100 (11989 x 2235 x 2550)			510 x 88 x 100 (12954 x 2235 x 2550)		
Unit Operating Weight, lbs. (kg)	23318 (10586)			25379 (11523)			26315 (11947)		
Unit Shipping Weight, lbs (kg)	22744 (10326)			24741 (11232)			25677 (11656)		
COMPRESSORS, SCREW, SEMI-HERMETIC									
Nominal Capacity, tons (kW)	100 (350)	100 (350)	100 (350)	100 (350)	100 (350)	125 (437)	100 (350)	125 (437)	125 (437)
CONDENSERS, HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER									
Coil Face Area, ft ² . (m ²)	159 (14.8)	159 (14.8)	159 (14.8)	159 (14.8)	159 (14.8)	213 (19.9)	159 (14.8)	213 (19.9)	213 (19.9)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3
CONDENSER FANS, DIRECT DRIVE PROPELLER TYPE									
No. of Fans -- Fan Diameter, in. (mm)	18 – 30 (762)			20 – 30 (762)			22 – 30 (732)		
No. of Motors -- hp (kW)	18 – 2 (1.5)			20 – 2 (1.5)			22 – 2 (1.5)		
Fan & Motor RPM, 60Hz	1140			1140			1140		
60 Hz Fan Tip Speed, fpm	8954			8954			8954		
60 Hz Total Unit Airflow, ft ³ /min	194,400			216,000			237,600		
EVAPORATOR, FLOODED SHELL AND TUBE									
Shell Dia., Tube Length in.(mm)	26 (660) – 108 (2743)			30 (762) – 108 (2743)			30 (762) – 108 (2743)		
Evaporator R-134a Charge lbs (kg)	164 (74)	164 (74)	164 (74)	191 (86)	191 (86)	191 (86)	191 (86)	191 (86)	191 (86)
Water Volume, gallons (liters)	63 (237)			70 (263)			70 (263)		
Max. Water Pressure, psi (kPa)	150 (1034)			150 (1034)			150 (1034)		
Max. Refrigerant Press., psi (kPa)	200 (1379)			200 (1379)			200 (1379)		

NOTE: Weights shown are for aluminum fin coils. Add 158 lbs. (72 kg) per fan to operating or shipping weights for copper fins.

Table 20, Physical Data, AGS 420B – AGS 440B

DATA	AGS MODEL NUMBER					
	420B			440B		
	Ckt. 1	Ckt. 2	Ckt. 3	Ckt. 1	Ckt. 2	Ckt. 3
BASIC DATA						
Unit Cap. @ ARI, tons (kW)	408.8 (1435)			427.1 (1499)		
Unit Operating Charge, lbs (kg)	335 (152)	335 (152)	335 (152)	358 (162)	358 (162)	358 (162)
Cabinet Dim., L x W x H, in. (mm)	548 x 88 x 100 (13919 x 2235 x 2550)			548 x 88 x 100 (13919 x 2235 x 2550)		
Unit Operating Weight, lbs. (kg)	27251 (12371)			27611(12537)		
Unit Shipping Weight, lbs (kg)	26613 (12081)			26885 (12204)		
COMPRESSORS, SCREW, SEMI-HERMETIC						
Nominal Capacity, tons (kW)	125 (437)	125 (437)	125 (437)	125 (437)	125 (437)	150 (525)
CONDENSERS, HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER						
Coil Face Area, ft ² . (m ²)	213 (19.9)	213 (19.9)	213 (19.9)	213 (19.9)	213 (19.9)	213 (19.9)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3
CONDENSER FANS, DIRECT DRIVE PROPELLER TYPE						
No. of Fans -- Fan Dia., in. (mm)	24 – 30 (762)			24 – 30 (762)		
No. of Motors -- hp (kW)	24 – 2 (1.5)			24 – 2 (1.5)		
Fan & Motor RPM, 60Hz	1140			1140		
60 Hz Fan Tip Speed, fpm	8954			8954		
60 Hz Total Unit Airflow, ft ³ /min	259,200			259,200		
EVAPORATOR, FLOODED SHELL AND TUBE						
Shell Dia. -- Tube Length in.(mm) - in. (mm)	30 (762) – 108 (2743)			30 (762) – 108 (2743)		
Evaporator R-134a Charge lbs (kg)	191 (86)	191 (86)	191 (86)	214 (97)	214 (97)	214 (97)
Water Volume, gallons (liters)	70 (263)			79 (300)		
Max. Water Pressure, psi (kPa)	150 (1034)			150 (1034)		
Max. Refrigerant Press., psi (kPa)	200 (1379)			200 (1379)		

NOTE: Weights shown are for aluminum fin coils. Add 158 lbs. (72 kg) per fan to operating or shipping weights for copper fins.

Table 21, Physical Data, AGS 450B – AGS 475B

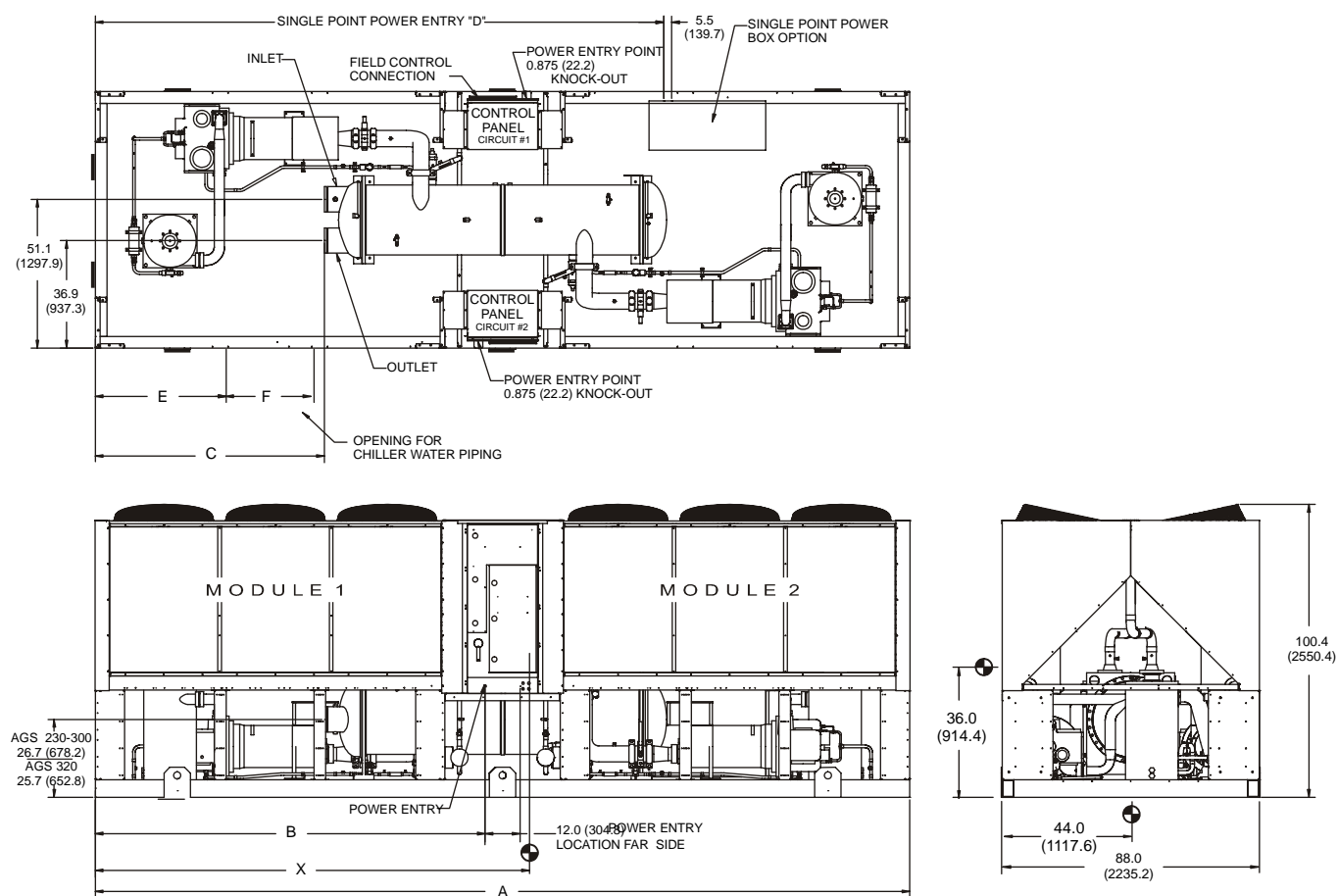
DATA	AGS MODEL NUMBER					
	450B			475B		
	Ckt. 1	Ckt. 2	Ckt. 3	Ckt. 1	Ckt. 2	Ckt. 3
BASIC DATA						
Unit Cap. @ ARI, tons (kW)	440.5 (1546)			453.9 (1593)		
Unit Operating Charge, lbs (kg)	358 (162)	358 (162)	358 (162)	358 (162)	358 (162)	358 (162)
Cabinet Dim., L x W x H, in. (mm)	548 x 88 x 100 (13919 x 2235 x 2550)			548 x 88 x 100 (13919 x 2235 x 2550)		
Unit Operating Weight, lbs. (kg)	27611 (12537)			27611 (12537)		
Unit Shipping Weight, lbs (kg)	26885 (12204)			26885 (12204)		
COMPRESSORS, SCREW, SEMI-HERMETIC						
Nominal Capacity, tons (kW)	125 (437)	150 (525)	150 (525)	150 (525)	150 (525)	150 (525)
CONDENSERS, HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER						
Coil Face Area, ft ² . (m ²)	213 (19.9)	213 (19.9)	213 (19.9)	213 (19.9)	213 (19.9)	213 (19.9)
Fins Per Inch x Rows Deep	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3	16 x 3
CONDENSER FANS, DIRECT DRIVE PROPELLER TYPE						
No. of Fans -- Fan Dia., in. (mm)	24 – 30 (762)			24 – 30 (762)		
No. of Motors -- hp (kW)	24 – 2 (1.5)			24 – 2 (1.5)		
Fan & Motor RPM, 60Hz	1140			1140		
60 Hz Fan Tip Speed, fpm	8954			8954		
60 Hz Total Unit Airflow, ft ³ /sec	259,200			259,200		
EVAPORATOR, FLOODED SHELL AND TUBE						
Shell Dia. -- Tube Length in.(mm) - in. (mm)	30 (762) – 108 (2743)			30 (762) – 108 (2743)		
Evaporator R-134a Charge lbs (kg)	214 (97)	214 (97)	214 (97)	214 (97)	214 (97)	214 (97)
Water Volume, gallons (liters)	79 (300)			79 (300)		
Max. Water Pressure, psi (kPa)	150 (1034)			150 (1034)		
Max. Refrigerant Press. psi (kPa)	200 (1379)			200 (1379)		

NOTE: Weights shown are for aluminum fin coils. Add 158 lbs. (72 kg) per fan to operating or shipping weights for copper fins.

Dimensional Data

Figure 23, Dimensions, AGS 230B – AGS 320B

Note: See page 16 for lifting locations, mounting locations, weights and mounting loads.



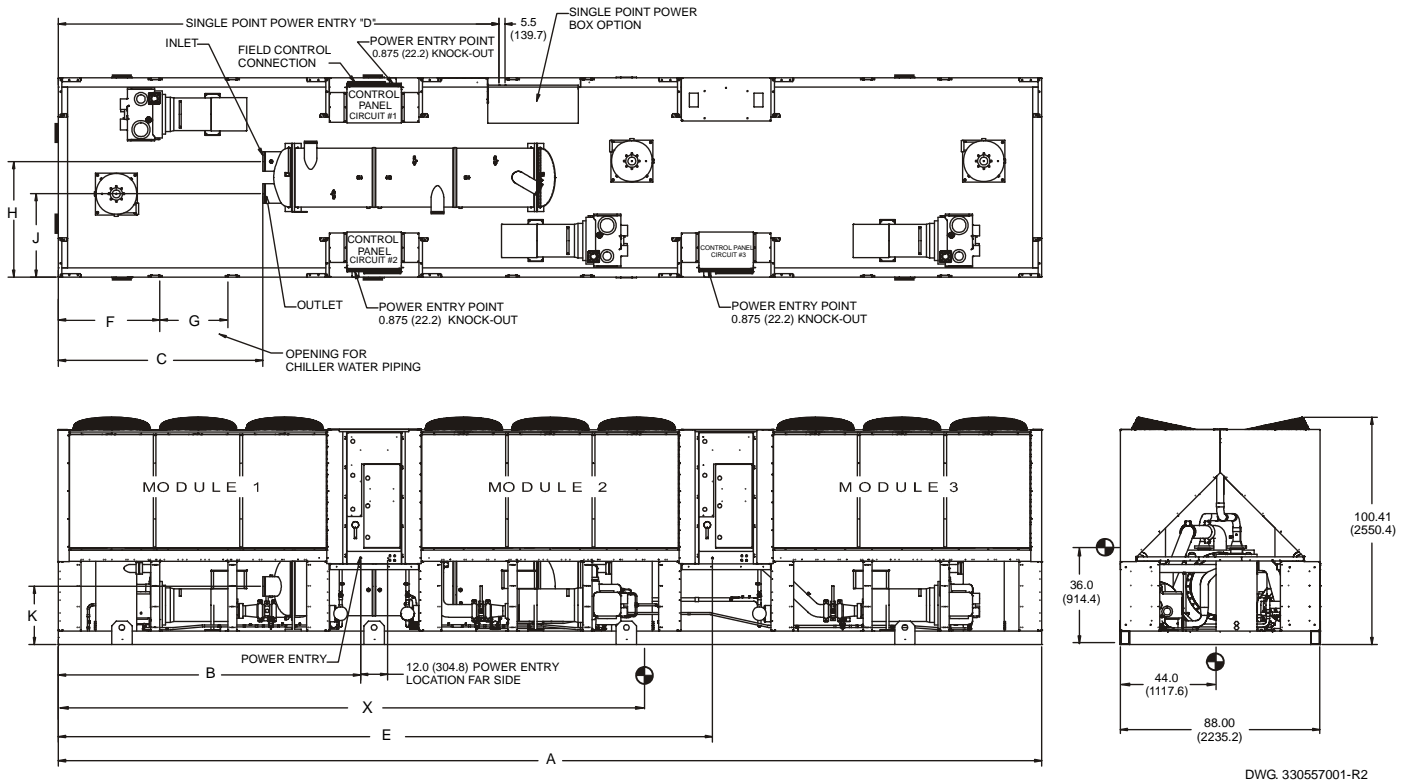
DWG. 330556901-R2

NOTE: Chilled water piping must enter and exit the unit platform between the base rail and the bottom of the condenser coil in the "F" dimension on the side shown above.

AGS Unit Size	Dimensions inches (mm)				Water Piping inches (mm)		Connection Sizes inches (mm)	Center of Gravity in. (mm) X	Fan Modules		
	A	B	C	D	E	F			No. of Fans	1	2
AGS 230	278.8 (7081.5)	133.4 (3388.4)	78.4 (1991.4)	192.6 (4892.0)	44.8 (1137.4)	30.0 (762.8)	8 (203.2)	139 (3531)	12 Fan	6	6
AGS 250	316.9 (8049.3)	133.4 (3388.4)	78.4 (1991.4)	192.6 (4892.6)	44.8 (1137.4)	30.0 (762.8)	8 (203.2)	146 (3708)	14 Fan	6	8
AGS 270-320	355.2 (9022.1)	171.6 (4358.6)	116.6 (2961.6)	230.8 (5862.3)	80.9 (2054.8)	31.4 (797.6)	8 (203.2)	177 (4496)	16 Fan	8	8

Figure 24, Dimensions, AGS 340B –475B

Note: See page 16 for lifting locations, mounting locations, weights and mounting loads.



NOTE: Chilled water piping must enter and exit the unit platform between the base rail and the bottom of the condenser coil in the "G" dimension on the side shown above.

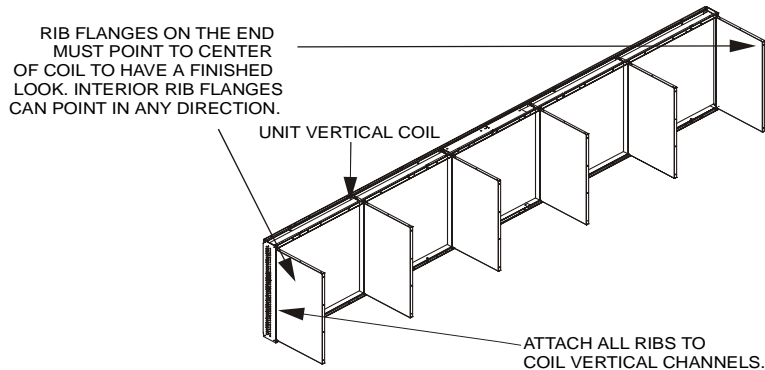
AGS Unit Size	Dimensions Inches (mm)					Water Piping inches (mm)		Connection Sizes inches (mm)	Center of Gravity in. (mm) X	Fan Modules			
	A	B	C	D	E	F	G			No. of Fans	1	2	3
340	434.2 (11027.9)	133.4 (3388.0)	90.3 (2292.4)	192.6 (4892.0)	288.8 (7335.5)	44.7 (1137.4)	30.0 (762.8)	8 (203.2)	210 (5334)	18	6	6	6
370	472.4 (11998.2)	133.4 (3388.1)	90.3 (2292.4)	192.6 (4892.0)	288.8 (7335.5)	44.7 (1137.4)	30.0 (762.8)	10 (254.0)	215 (5461)	20	6	6	8
400	510.6 (12968.5)	133.4 (3388.1)	87.3 (2140.0)	192.6 (4892.0)	327.0 (8305.8)	44.7 (1137.4)	30.0 (762.8)	10 (254.0)	228 (5791)	22	6	8	8
420-475	548.8 (13939.0)	171.6 (4358.4)	125.5 (3186.4)	230.8 (5862.3)	365.2 (9276.1)	80.9 (2054.8)	31.4 (797.6)	10 (254.0)	260 (6604)	24	8	8	8

Wind Baffles and Hail Guards

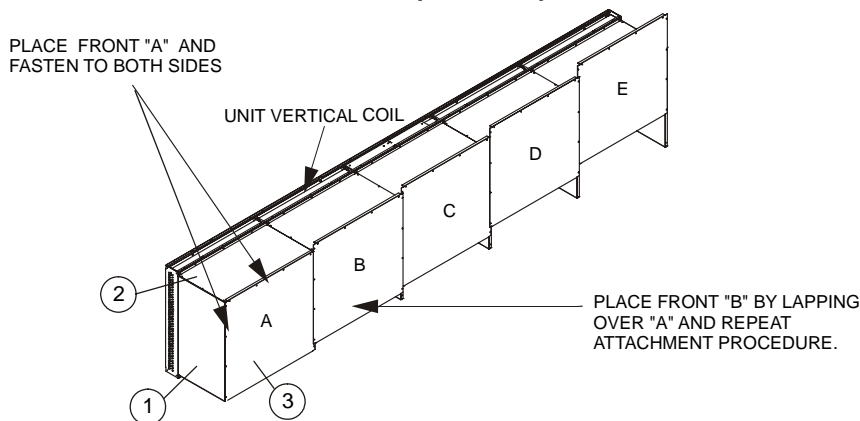
Wind Baffles/Hail Guards are a field installed option that are used to stabilize unit operation in high wind areas and to assist in operation at low ambient temperatures. Figure 25 shows a typical panel assembly on an AGS unit. The actual number of panels and parts will vary by model size. The parts are shown in the table below and referenced by balloon numbers. The baffles extend out 20 inches from each side.

Figure 25, Installation Sequence

Rib Attachment (First)



Front Panel Attachment (Second)



Top Panel Attachment (Last)

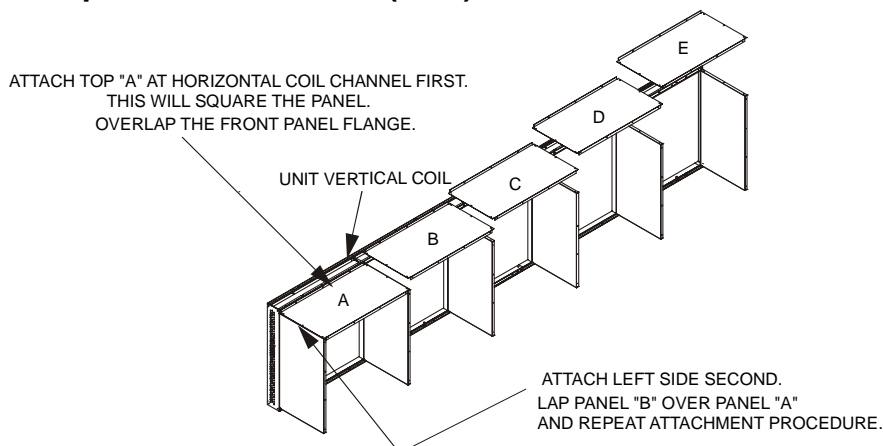
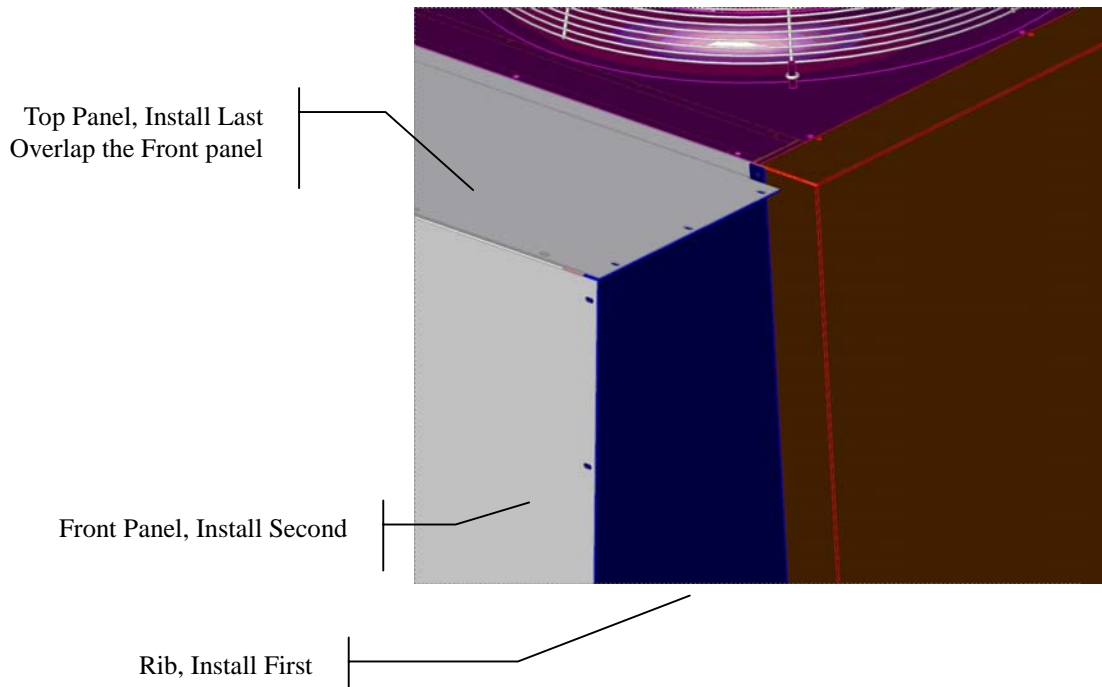
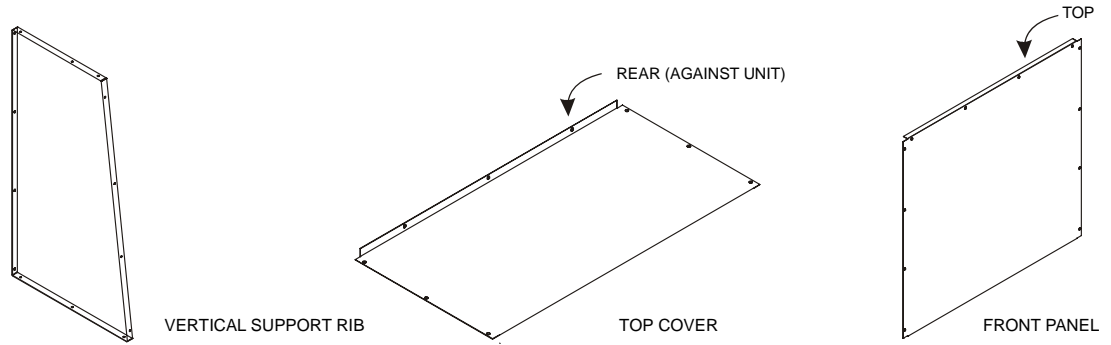


Table 22, Packing List

Description	Part Number	Bubble Number
Vertical Support Rib	074758501	1
Top Cover	330409401	2
Front Panel	330409501	3
$\frac{1}{4}$ - 20 x $\frac{1}{2}$ " Screw (Place in Poly Bag)		
	046093807	

Figure 26, Components



Electrical Data

Field Wiring

General

Wiring must comply with all applicable codes and ordinances. Damage to the equipment caused by wiring not complying with specifications is not covered under warranty.

An open fuse or circuit breaker indicates a short, ground, or overload. Before replacing a fuse or restarting a compressor or fan motor, the trouble must be found and corrected.

Copper wire is required for all power lead terminations at the unit and copper must be used for all other wiring to the unit.

AGS units can be ordered with main power wiring for either multiple-point power (standard) or single-point connection (optional).

If the standard multiple-point power wiring is ordered, power connections are made to the individual circuit power blocks in power panels located between the condenser sections. Two connections are required for models AGS 230 through 320 and three are required for models AGS 340 through 475. See the dimension drawings on pages 30 and 31 for detailed locations. Separate disconnects are required for each electrical circuit if McQuay factory-mounted disconnects with through-the-door handles are not ordered.

If the optional single-point power connection is ordered, a single large power connection point is provided and located in a box on the base of the unit. See the dimension drawings on pages 30 and 31 for the location. Factory wiring from the box to the individual compressor power panels on the unit is sized in accordance with the National Electrical Code. A disconnect is required and can be furnished as a factory option. Each circuit has a factory wired compressor isolation circuit breaker. The 115-volt control transformer is factory mounted and wired.

It can be desirable to have the unit evaporator heaters on a separate disconnect switch from the main unit power supply so that the unit power can be shut down without defeating the freeze protection provided by the cooler heaters. See page 21 for details.



CAUTION

The heaters come from the factory connected to the control power circuit. If desired, the 3 KVA control transformer can be unwired and a field 115-volt power source wired to terminals TB1-1 and TB1-2 in the control panel for circuit #1 (do not wire directly to the heater). If this is done, the disconnect switch should be clearly marked to avoid accidental deactivation of the heater during freezing temperatures. Exposed chilled water piping also requires protection.

Power blocks are standard on all size units. Multi-point power connections can have circuit breakers as an option. The single-point circuit breaker option has a main circuit breaker and individual breakers in each panel.



CAUTION

AGS unit compressors are single-direction rotation compressors and can be damaged if rotated in the wrong direction. For this reason proper phasing of electrical power is important. Electrical phasing must be A, B, C for electrical phases 1, 2 and 3 (A=L1, B=L2, C=L3) for single or multiple point wiring arrangements. The solid-state starters contain phase reversal protection.

DO NOT ALTER THE WIRING TO THE STARTERS.

Table 23, AGS 230B – AGS 475B, Electrical Data, Optional Single-Point

AGS UNIT SIZE	VOLTS	HZ	MINIMUM CIRCUIT AMPACITY (MCA)	POWER SUPPLY				FIELD FUSE SIZE or HACR BREAKER SIZE	
				FIELD WIRE		HUB (Conduit Connection)			
				QTY	WIRE GAUGE	QTY	NOMINAL SIZE (In.)	RECOM- MENDED	MAXIMUM
230	460	60	475	6	250	2	2.5	600	600
	575		418	6	4/0	2	2.0	500	500
250	460	60	519	6	300	2	3.0	600	700
	575		447	6	4/0	2	2.0	500	600
270	460	60	555	6	300	2	3.0	700	700
	575		471	6	250	2	2.5	600	600
300	460	60	586	6	350	2	3.0	700	800
	575		496	6	250	2	2.5	600	700
320	460	60	611	6	350	2	3.0	700	800
	575		516	6	300	2	3.0	600	700
340	460	60	688	12	4/0	2	3.0	800	800
	575		605	12	3/0	2	3.0	700	700
370	460	60	732	12	250	2	4.0	800	800
	575		634	12	3/0	2	3.0	700	800
400	460	60	768	12	250	2	4.0	800	800
	575		658	12	4/0	2	3.0	800	800
420	460	60	804	12	250	2	4.0	1000	1000
	575		683	12	4/0	2	3.0	800	800
440	460	60	835	12	300	2	4.0	1000	1000
	575		708	12	4/0	2	3.0	800	800
450	460	60	860	12	300	2	4.0	1000	1000
	575		728	12	4/0	2	3.0	800	800
475	460	60	885	12	300	2	4.0	1000	1000
	575		748	12	250	2	4.0	800	800

Notes:

1. Table based on 75°C field wire.
2. A "HACR" breaker is a circuit breaker designed for use on equipment with multiple motors. It stands for Heating, Air Conditioning, and Refrigeration.
3. Complete electrical notes are on page 39.

Table 24, AGS 230B – AGS 320B, Electrical Data, Standard Multiple-Point, Two-Circuit Units

AGS UNIT SIZE	VOLTS	HZ	ELECTRICAL CIRCUIT 1 (COMP 1)							ELECTRICAL CIRCUIT 2 (COMP 2)						
			MIN. CIRCUIT AMPS (MCA)	POWER SUPPLY				FIELD FUSING		MIN. CIRCUIT AMPS (MCA)	POWER SUPPLY				FIELD FUSING	
				FIELD WIRE		HUB (Conduit Connection)		REC FUSE SIZE	MAX FUSE SIZE		FIELD WIRE		HUB (Conduit Connection)		REC FUSE SIZE	MAX FUSE SIZE
230	460	60	262	6	3/0 (3)	1	3.0	350	450	262	6	3/0 (3)	1	3.0	350	450
	575		230	3	250	1	2.5	300	400	230	3	250	1	2.5	300	400
250	460	60	262	6	3/0 (3)	1	3.0	350	450	306	6	3/0	1	3.0	400	500
	575		230	3	250	1	2.5	300	400	260	6	3/0 (3)	1	3.0	350	400
270	460	60	306	6	3/0	1	3.0	400	500	306	6	3/0	1	3.0	400	500
	575		260	6	3/0 (3)	1	3.0	350	400	260	6	3/0 (3)	1	3.0	350	400
300	460	60	306	6	3/0	1	3.0	400	500	337	6	4/0	1	3.0	450	500
	575		260	6	3/0 (3)	1	3.0	350	400	285	6	3/0	1	3.0	350	450
320	460	60	337	6	4/0	1	3.0	450	500	337	6	4/0	1	3.0	450	500
	575		285	6	3/0	1	3.0	350	450	285	6	3/0	1	3.0	350	450

Notes:

1. Table based on 75°C field wire.
2. Complete electrical notes are on page 39.
3. 3/0 wire is required for the disconnect switch option, 2/0 can be used for power block connection.

Table 25, AGS 340B–AGS 475B, Electrical Data, Standard Multiple-Point, (Circuits # 1 & 2)

AGS UNIT SIZE	VOLTS	HZ	ELECTRICAL CIRCUIT 1 (COMP 1)							ELECTRICAL CIRCUIT 2 (COMP 2)						
			MIN. CIRCUIT AMPS (MCA)	POWER SUPPLY				FIELD FUSING		MIN. CIRCUIT AMPS (MCA)	POWER SUPPLY				FIELD FUSING	
				FIELD WIRE		HUB (Conduit Connection)		REC FUSE SIZE	MAX FUSE SIZE		FIELD WIRE		HUB (Conduit Connection)		REC. FUSE SIZE	MAX. FUSE SIZE
340	460	60	262	6	3/0 (3)	1	3.0	350	450	262	6	3/0 (3)	1	3.0	350	450
	575		230	3	250	1	2.5	300	400	230	3	250	1	2.5	300	400
370	460	60	262	6	3/0 (3)	1	3.0	350	450	262	6	3/0 (3)	1	3.0	350	450
	575		230	3	250	1	2.5	300	400	230	3	250	1	2.5	300	400
400	460	60	262	6	3/0 (3)	1	3.0	350	450	306	6	3/0	1	3.0	400	500
	575		230	3	250	1	2.5	300	400	260	6	3/0 (3)	1	3.0	350	400
420	460	60	306	6	3/0	1	3.0	400	500	306	6	3/0	1	3.0	400	500
	575		260	6	3/0 (3)	1	3.0	350	400	260	6	3/0 (3)	1	3.0	350	400
440	460	60	306	6	3/0	1	3.0	400	500	306	6	3/0	1	3.0	400	500
	575		260	6	3/0 (3)	1	3.0	350	400	260	6	3/0 (3)	1	3.0	350	400
450	460	60	306	6	3/0	1	3.0	400	500	337	6	4/0	1	3.0	450	500
	575		260	6	3/0 (3)	1	3.0	350	400	285	6	3/0	1	3.0	350	450
475	460	60	337	6	4/0	1	3.0	450	500	337	6	4/0	1	3.0	450	500
	575		285	6	3/0	1	3.0	350	450	285	6	3/0	1	3.0	350	450

Notes:

1. Table based on 75°C field wire.
2. Complete electrical notes are on page 39.
3. 3/0 wire is required for the disconnect switch option, 2/0 can be used for power block connection.

Table 25, Electrical Data, AGS 340B – 475B, (Circuit #3)

AGS UNIT SIZE	VOLTS	HZ	ELECTRICAL CIRCUIT 3 (COMP 3)						
			MINIMUM CIRCUIT AMPS (MCA)	POWER SUPPLY				FIELD FUSING	
				FIELD WIRE		HUB (Conduit Connection)		REC. FUSE SIZE	MAX. FUSE SIZE
				QTY	WIRE GAUGE	QTY	HUB SIZE		
340	460	60	262	6	3/0 (3)	1	3.0	350	450
	575		230	3	250	1	2.5	300	400
370	460	60	306	6	3/0	1	3.0	400	500
	575		260	6	3/0 (3)	1	3.0	350	400
400	460	60	306	6	3/0	1	3.0	400	500
	575		260	6	3/0 (3)	1	3.0	350	400
420	460	60	306	6	3/0	1	3.0	400	500
	575		260	6	3/0 (3)	1	3.0	350	400
440	460	60	337	6	4/0	1	3.0	450	500
	575		285	6	3/0	1	3.0	350	450
450	460	60	337	6	4/0	1	3.0	450	500
	575		285	6	3/0	1	3.0	350	450
475	460	60	337	6	4/0	1	3.0	450	500
	575		285	6	3/0	1	3.0	350	450

Notes:

1. Table based on 75°C field wire.
2. Complete electrical notes are on page 39.
3. 3/0 wire is required for the disconnect switch option, 2/0 can be used for power block connection.

Table 26, AGS230B–AGS 475B, Compressor and Condenser Fan Motor Amp Draw

AGS UNIT SIZE	VOLTS	HZ	RATED LOAD AMPS			NO OF FAN MOTORS	FAN MOTORS FLA (EACH)	L R A FAN MOTORS (EACH)
			CIRCUIT #1	CIRCUIT #2	CIRCUIT #3			
230	460	60	195	195	-	12	3.0	20
	575		171	171	-		2.7	18
250	460	60	195	225	-	14	3.0	20
	575		171	190	-		2.7	18
270	460	60	225	225	-	16	3.0	20
	575		190	190	-		2.7	18
300	460	60	225	250	-	16	3.0	20
	575		190	210	-		2.7	18
320	460	60	250	250	-	16	3.0	20
	575		210	210	-		2.7	18
340	460	60	195	195	195	18	3.0	20
	575		171	171	171		2.7	18
370	460	60	195	195	225	20	3.0	20
	575		171	171	190		2.7	18
400	460	60	195	225	225	22	3.0	20
	575		171	190	190		2.7	18
420	460	60	225	225	225	24	3.0	20
	575		190	190	190		2.7	18
440	460	60	225	225	250	24	3.0	20
	575		190	190	210		2.7	18
450	460	60	225	250	250	24	3.0	20
	575		190	210	210		2.7	18
475	460	60	250	250	250	24	3.0	20
	575		210	210	210		2.7	18

Table 27, AGS 230B – AGS 475B, Customer Wiring Information With Single-Point Power

AGS UNIT SIZE	VOLTS	HZ	WIRING TO STANDARD UNIT POWER BLOCK		WIRING TO OPTIONAL NONFUSED DISCONNECT SWITCH IN UNIT	
			TERMINAL SIZE AMPS	CONNECTOR LUG RANGE PER PHASE (COPPER WIRE ONLY)	SIZE	CONNECTOR LUG RANGE PER PHASE (COPPER WIRE ONLY)
230	460	60	1000	#6-350	800	#6-350
	575		1000	#6-350	800	#6-350
250	460	60	1000	#6-350	800	#6-350
	575		1000	#6-350	800	#6-350
270	460	60	1000	#6-350	800	#6-350
	575		1000	#6-350	800	#6-350
300	460	60	1000	#6-350	800	#6-350
	575		1000	#6-350	800	#6-350
320	460	60	1000	#6-350	800	#6-350
	575		1000	#6-350	800	#6-350
340	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350
370	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350
400	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350
420	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350
440	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350
450	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350
475	460	60	1000	#6-350	1000	#6-350
	575		1000	#6-350	800	#6-350

1. Terminal size amps are the maximum amps that the power block is rated for.
2. Complete notes are on page 39.

Table 28, AGS 230B–AGS 475B, Wiring Information with Multiple-Point

AGS UNIT SIZE	VOLTS	HZ	WIRING TO UNIT POWER BLOCK					
			TERMINAL SIZE (AMPS)			CONNECTOR WIRE RANGE PER PHASE (COPPER WIRE ONLY)		
			CKT 1	CKT 2	CKT 3	CKT 1	CKT 2	CKT 3
230	460	60	400	400	--	#6-350	#6-350	--
	575							
250	460	60	400	400	--	#6-350	#6-350	--
	575							
270	460	60	400	400	--	#6-350	#6-350	--
	575							
300	460	60	400	400	--	#6-350	#6-350	--
	575							
320	460	60	400	400	--	#6-350	#6-350	--
	575							
340	460	60	400	400	400	#6-350	#6-350	#6-350
	575							
370	460	60	400	400	400	#6-350	#6-350	#6-350
	575							
400	460	60	400	400	400	#6-350	#6-350	#6-350
	575							
420	460	60	400	400	400	#6-350	#6-350	#6-350
	575							
440	460	60	400	400	400	#6-350	#6-350	#6-350
	575							
450	460	60	400	400	400	#6-350	#6-350	#6-350
	575							
475	460	60	400	400	400	#6-350	#6-350	#6-350
	575							

Notes:

1. Terminal size amps are the maximum amps that the power block is rated for.
2. Complete electrical notes are on page 39.

Table 29, AGS 230B–AGS 475B, Wiring Information with Multiple-Point

AGS UNIT SIZE	VOLTS	HZ	WIRING TO UNIT DISCONNECT SWITCH					
			TERMINAL SIZE (AMPS)			CONNECTOR WIRE RANGE PER PHASE (COPPER WIRE ONLY)		
			CKT 1	CKT 2	CKT 3	CKT 1	CKT 2	CKT 3
230	460	60	400	400	-	3/0 - 500	3/0 - 500	-
	575							
250	460	60	400	400	-	3/0 - 500	3/0 - 500	-
	575							
270	460	60	400	400	-	3/0 - 500	3/0 - 500	-
	575							
300	460	60	400	400	-	3/0 - 500	3/0 - 500	-
	575							
320	460	60	400	400	-	3/0 - 500	3/0 - 500	-
	575							
340	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							
370	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							
400	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							
420	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							
440	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							
450	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							
475	460	60	400	400	400	3/0 - 500	3/0 - 500	3/0 - 500
	575							

Electrical Data Notes

1. Allowable voltage limits
Unit nameplate 460V/60Hz/3Ph: 414V to 506V
Unit nameplate 575V/60Hz/3Ph: 518V to 632V
2. Unit wire size ampacity (MCA) is equal to 125% of the largest compressor-motor RLA plus 100% of RLA of all other loads in the circuit.
3. Single point power supply requires a single disconnect to supply electrical power to the unit. This power must be fused.
4. All field wiring to unit power block or optional nonfused disconnect switch must be copper.
5. External disconnect switch(s) or HACR breakers must be field supplied.
Note: A non-fused disconnect switch in the cabinet is available as an option for single-point or multi-point power connections.
6. All wiring must installed as NEC Class 1 wiring system with conductor rated 600 volts and be done in accordance with applicable local and national codes.
7. Recommended time delay fuse size or HACR circuit breakers is equal to 150% of the largest compressor motor RLA plus 100% of remaining compressor RLAs and the sum of condenser fan FLAs.
8. Maximum time delay fuse size or HACR circuit breakers is equal to 225% of the largest compressor-motor RLA plus 100% of remaining compressor RLAs and the sum of condenser fan FLAs.
9. If 1) the evaporator heater is to be powered during winter shutdown and 2) it is desired to disconnect 460/575 volt power to the unit, then the unit-mounted 3 KVA control transformer can be unwired and a field 115-volt, 30-amp power source wired to terminals TB1-1 and TB1-2. The MicroTech II control must be powered in order for the heaters to work.

Power Limitations:

1. Voltage within ± 10 percent of nameplate rating.
2. Voltage unbalance not to exceed 2% with a resultant current unbalance of 6 to 10 times the voltage unbalance per NEMA MG-1, 1998 Standard.

Optional Protocol Selectability Connection

Optional Protocol Selectability BAS interfaces. The locations and interconnection requirements for the various standard protocols are found in their respective installation manuals, obtainable from the local McQuay sales office and also shipped with each unit:

Modbus IM 743

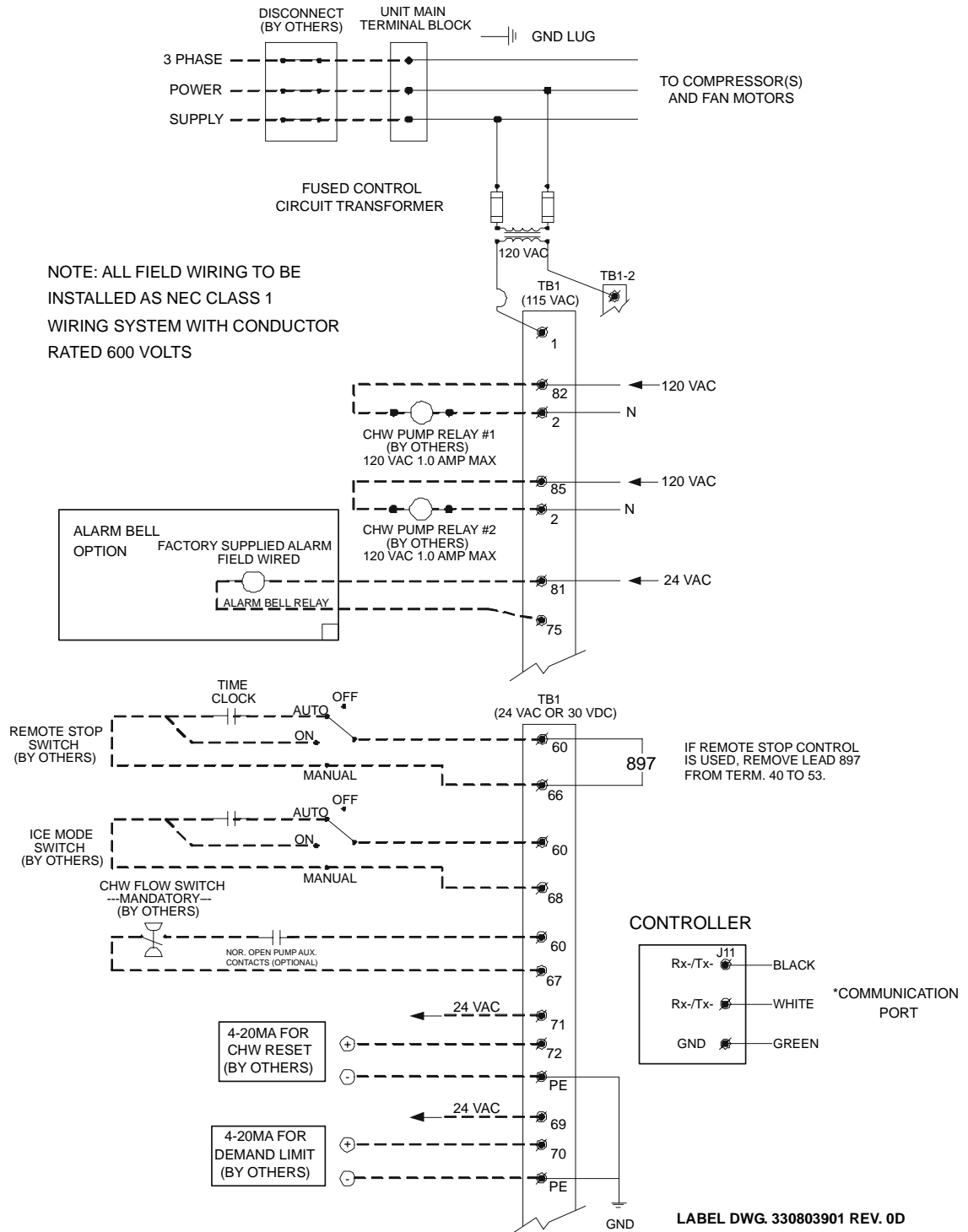
LONWORKS IM 735

BACnet IM 736

Field Wiring Diagram

Figure 27, Typical Field Wiring Diagram, Circuit #1 Control Box

Note: Field-wired control connections are made in the control panel for circuit 1 only.



Solid State Starters

Solid state starters are standard on all AGS units. A solid state starter uses a silicon-controlled rectifier (SCR) power section to allow a motor to be brought to full speed with a reduced initial voltage that increases to full line voltage over a given time. The McQuay motor starter, custom designed for this specific application, is microprocessor controlled. Along with this starting technique, the motor starter also provides protection for the motor and monitors its load conditions.

The starter offers:

- Solid state design.
- Closed-loop motor current control.
- Programmable motor protection.
- Programmable operating parameters.
- Programmable metering options.

The three-phase starter contains a six-SCR power section with two SCRs per phase connected in inverse parallel. This power section is capable of providing maximum torque per amp throughout the motor's speed-torque curve with minimal motor and starter heating. At the same time, the starter continually monitors the amount of current being delivered to the motor, thus helping protecting the motor from overheating or drawing excessive current. The starter will automatically stop the motor if the line-to-line current is not within acceptable ranges, or if the current is lost in a line. The motor current scaling is set according to the motor size and the specific application. The starter circuitry is contained on a single printed circuit board, which contains all the logic and SCR gate drive circuitry.

Operating messages are displayed on a three-character LED display located in each compressor's control panel. The LED display on the control card displays:

- Operating messages that indicate the status of the motor and/or starter.
- Operating parameters that are programmed into the starter.
- Fault codes that indicate a problem with the motor application or starter.

Operating Messages

Possible operating messages are as follows:

Message	Meaning
noL	Line voltage is not present.
rdy	Line voltage is present and starter is ready.
acc	Motor is accelerating after a start command has been received.
uts	The motor has achieved full speed.
run	Motor is operating at full speed, and ramp time has expired.
dCL	A Stop command was received and the motor is decelerating with the set deceleration profile.

OL	OL will alternately blink with the normal display on the LED display when motor thermal overload content has reached 90% to 99% of its capacity.
OLL	The motor thermal overload content has reached 100%, and the motor has stopped. The motor cannot be restarted until the overloaded motor has cooled and OLt is displayed.
OLt	The motor thermal overload content has been reduced to 60% or less, and the motor can be restarted.
ena	Passcode protection is enabled.
dis	Passcode is disabled.
oxx	xx = overload thermal content in percentage. Press the Down button to toggle to this display.
cxx	xx = pending fault.
no	Attempted to change a passcode protected parameter without proper security.
...	Three decimal places blink when remote display is active.
Fxx	xx Fault Code

Fault Codes

Fault codes will be displayed on the red, three-character LED display. Fault codes indicate a problem with the starter or motor application.

<u>CODE</u>	<u>CRITICAL</u>	<u>DESCRIPTION</u>
F1	YES	Line phase sequence not ABC
F3	YES	System power is not three phase
F5		Line frequency less than 25hz.
F6		Line frequency greater than 72hz.
F23		Line current unbalance greater than set level.
F24		Line currents are very unbalanced.
F29	YES	Operating parameters have been lost
F30	YES	3-phase default operating parameters have been loaded
F31		1- phase default operating parameters have been loaded (N/A)
F52		Current flow is present while starter is in stopped state.
F54		Undercurrent trip
F55		Overcurrent trip
F70		Control power is low
F71	YES	CT burden switch changed while running.
F73	YES	Bypass fault
F74		Motor stall time elapsed before motor reached full speed.
F75		External Fault occurred. Thermistor/Motor Saver/Stack over temperature/Bypass (Power removed from input).
F77	YES	Control card fault
F78	YES	Control card fault
F90	YES	Full-load amp(P1), CT ratio, or CT Burden Switch set incorrectly.
F91	YES	RLA not correct
F92	YES	Shorted SCR or excessively high current imbalance.
F97	YES	Control card fault
F98		Lost main power
F99	YES	Excessively high load current.

Starter Preventative Maintenance

During commissioning:

- Torque all power connections during commissioning. This includes factory wired components.
- Check all of the control wiring in the package for loose connections.

During the first month after the starter has been put in operation:

- Re-torque all power connections every two weeks. This includes factory-wired components.
- Inspect cooling fans (if applicable) after two weeks for proper operation.

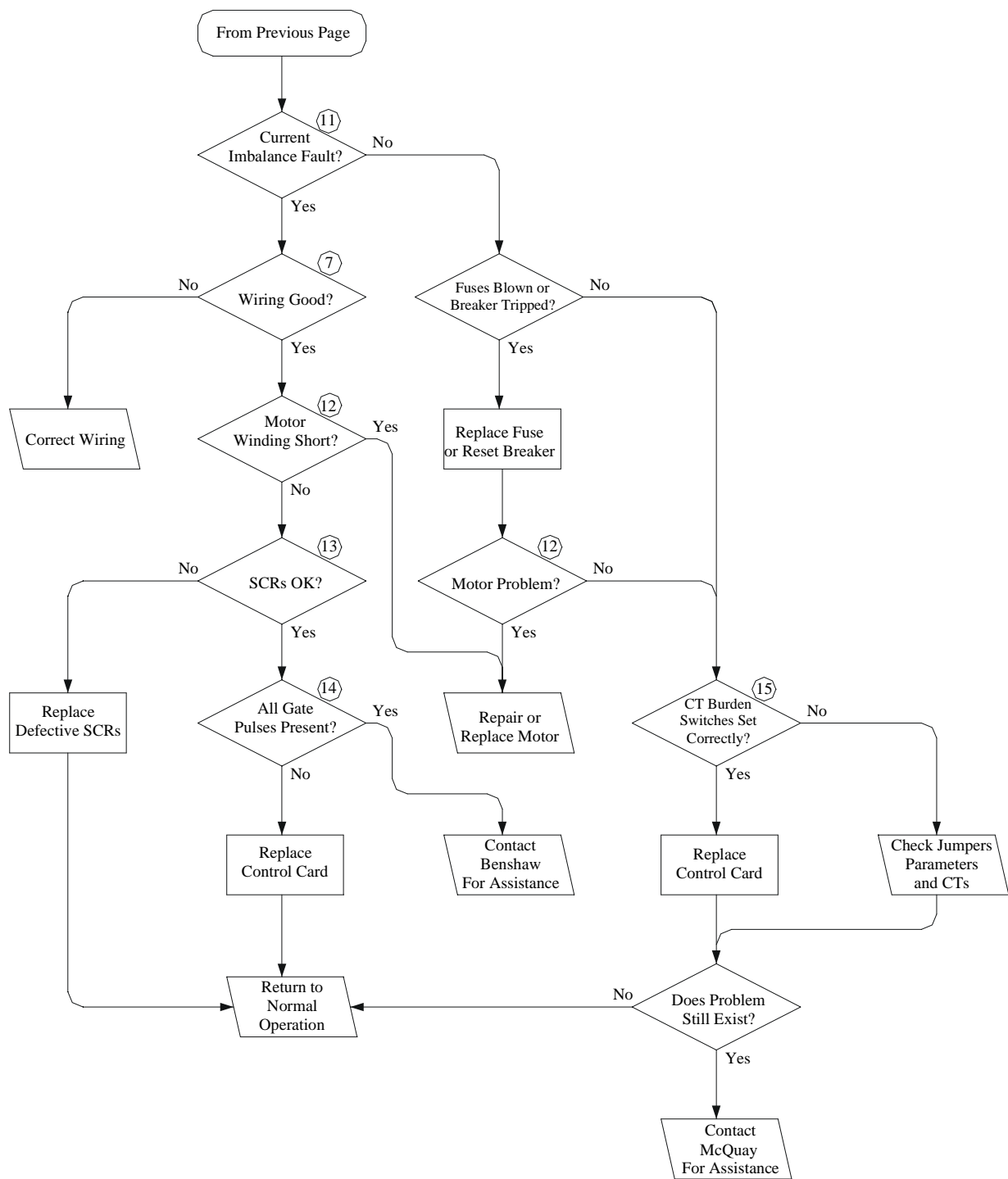
After the first month of operation:

- Re-torque all power connections every year.
- Clean any accumulated dust from the starter using a clean source of compressed air.
- Inspect the cooling fans every three months for proper operation.
- Clean or replace any air vent filters on the starter every three months.

NOTE: If mechanical vibrations are present at the installation site, inspect the connections more frequently.

Figure 28, Trouble Shooting Guide





FLOW CHART DETAILS:

- | | |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Fuses | Determine if power line fuses have been installed, and if they are operating properly. |
| 2. Circuit Breaker | Determine if the circuit breaker is off, or has tripped and disconnected the line from the starter. |
| 3. Power Line Voltage | Verify that line voltage is present, and is the correct voltage. |
| 4. Phase Order Fault | If Fault Codes F1 or F2 are displayed on the control card LED display, exchange any two incoming power line cable connections. |
| 5. Heat Sink Switch | Investigate whether heat sink thermal switch is open. |
| 6. Safety Device | Determine if an equipment protection device attached to the starter is disabling the start command. |
| 7. Wiring Connections | Verify that the wiring connections are correct and that the terminations are tightened. |
| 8. Air Temperature | Investigate whether the air temperature surrounding the heat sink is hot. |
| 9. Air Circulation | Determine if the airflow around the heat sink fins is being restricted, or if a fan has failed. |
| 10. Motor Overload | Determine if the motor's load is too large for the motor size. |
| 11. Current Imbalance Fault | If Fault Codes F23 or F24 are displayed on the control card LED display, diagnose and correct the cause of the current imbalance parameter P16 . |
| 12. Motor Winding Problem | Conducting a megger test of the motor can identify an internal motor winding problem. NOTE: To avoid damaging the starter isolate the motor before conducting the megger test. |



WARNING

Hazardous voltages exist at the starter terminals. LOCK OUT ALL OF THE POWER SOURCES before making resistance measurements to avoid personal injury or death.

- | | |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13. SCRs | <p>This step can help determine if a problem exists with the SCRs. Using a multi-meter or similar device, measure the resistance between:</p> <ul style="list-style-type: none">• L1 terminal and T1 terminal• L2 terminal and T2 terminal• L3 terminal and T3 terminal <p>The resistance should be more than 50k ohms. Measure the gate resistance between the white and red of each twisted pair (6 total). The gate resistance should be between 8 and 50 ohms.</p> |
| 14. Gate Pulses | <p>This step can help to determine if the control card is functioning properly. Check for gate firing voltage between 0.3 and 1.5 volts when the card is operating.</p> |
| 15. Motor Current | <p>Determine if motor current signal scaling is correct.</p> |

Solid State Starter Settings

Operating Parameters Settings for Default Value and Settable Range:

No.	Operating Parameter	Default	Range of Setting
P1	Motor Full Load Amps (FLA)	250A	1 to 350A
P2	Motor Rated Load Amps (RLA)	1A	1 to 350A
P3	Initial Motor Starting Current	225%	100 – 350%
P4	Max. Motor Starting Current	300%	200 – 350%
P5	Motor Ramp Time	7 sec	2 – 10 sec
P6	Motor Stall Time	10 sec	5 – 10 sec
P7	Deceleration Level 1	28%	40 – 100%
P8	Deceleration Level 2	10%	0 – 20%
P9	Deceleration Time	2 sec	Off, 1 – 10 sec
P10	Overcurrent Trip Level	140%	140%
P11	Overcurrent Trip Time	2 sec	Off, 1 – 15 sec
P12	Undercurrent Trip Level	25%	25% - 100%
P13	Undercurrent Trip Time	Off	Off, 1 – 15 sec
P14	Motor Current Imbalance	15%	5, 10, 15, 20%
P15	Current Transformer Ratio 460V/575V	2.64	RSD Standard
P16	Meter Mode	10	RSD Standard
P17	Meter Dwell Time	2	Off, 2 – 30 sec
P18	Passcode	Off	0 to 255 (enable), Off (disable)
P19	Kick Start	Off	On, Off
P20	Auto Reset Capability	Off	On, Off

Component Location

Major Component Location

Figure 29, Two-Compressor Unit Cutaway

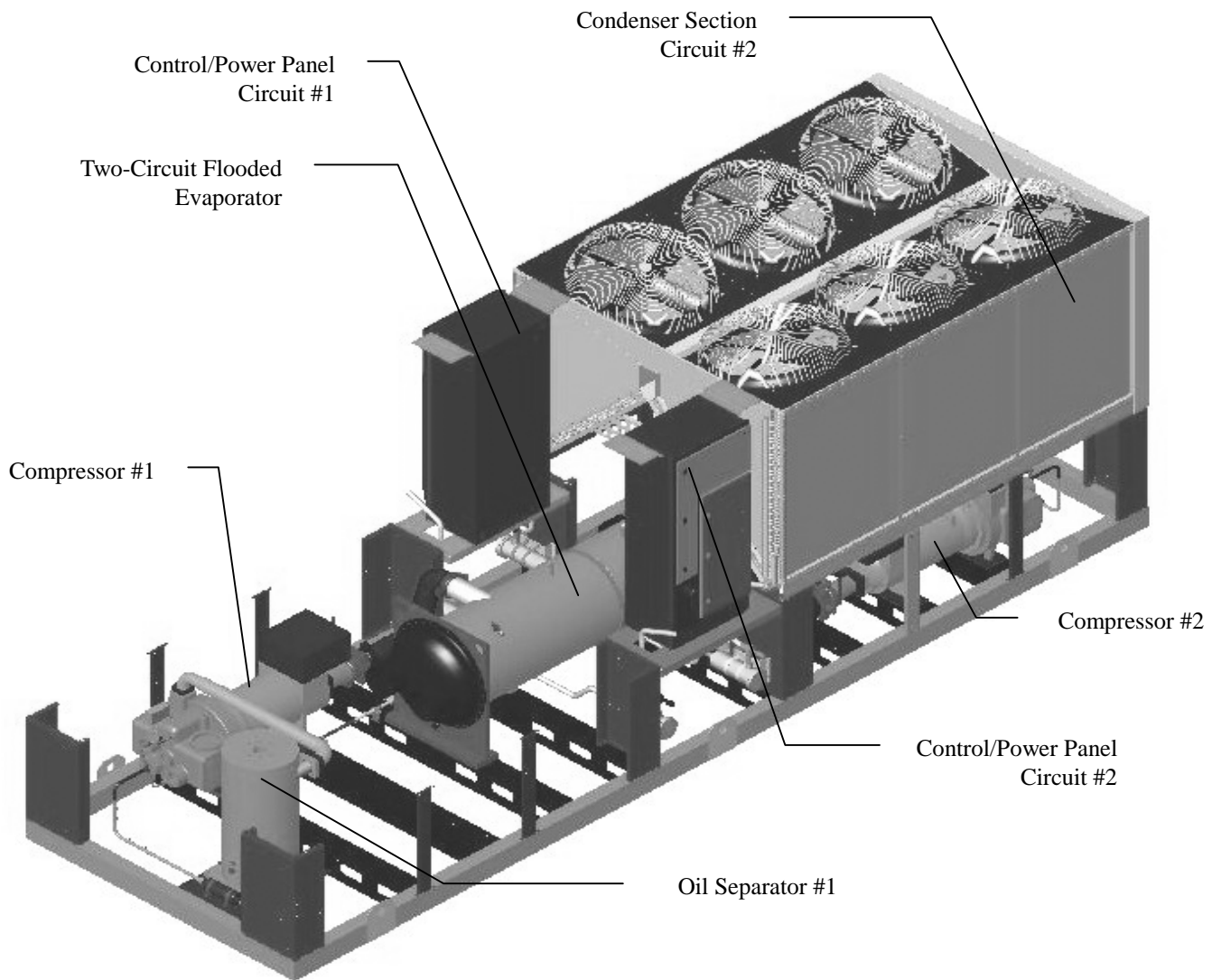
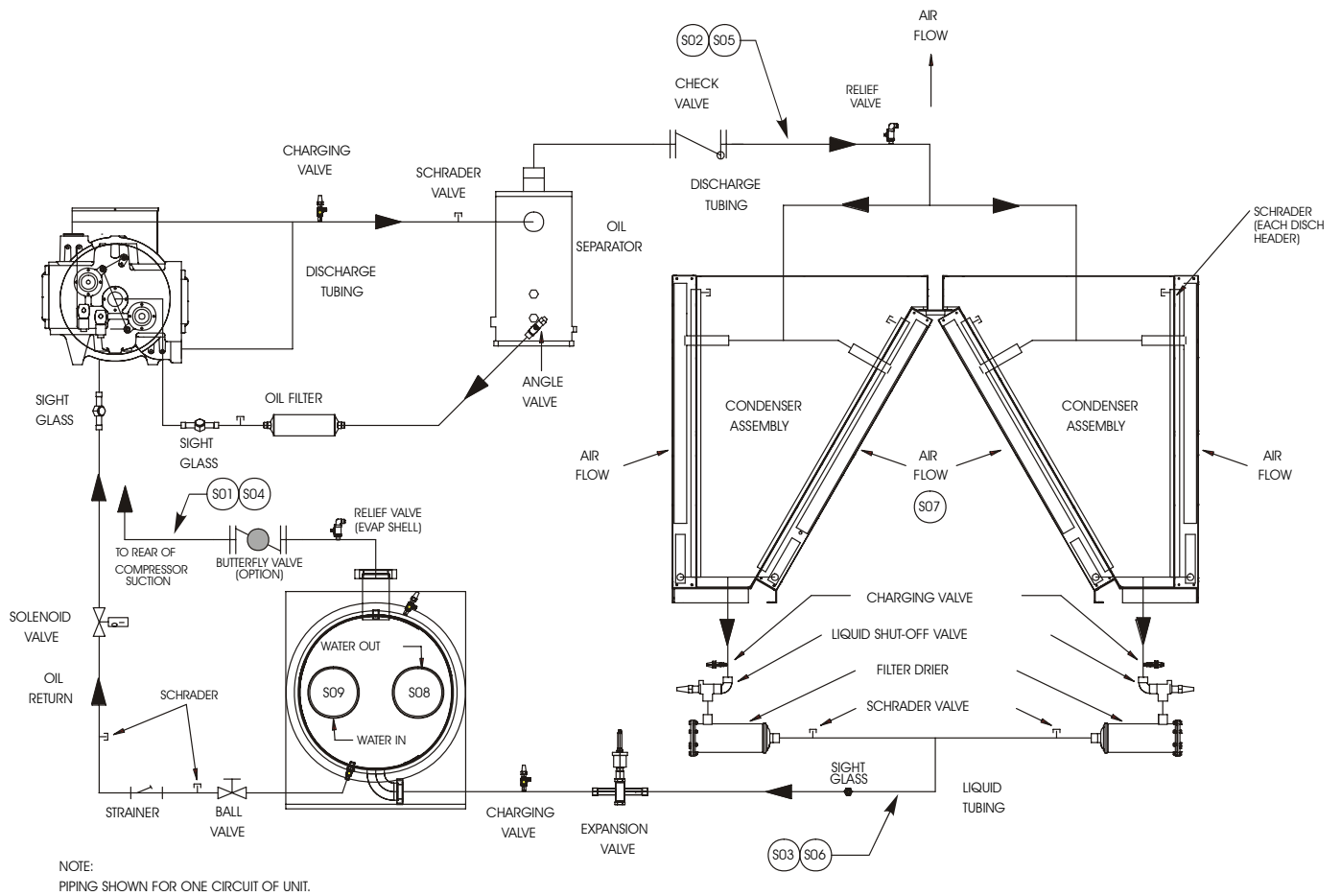


Figure 30, Piping Schematic

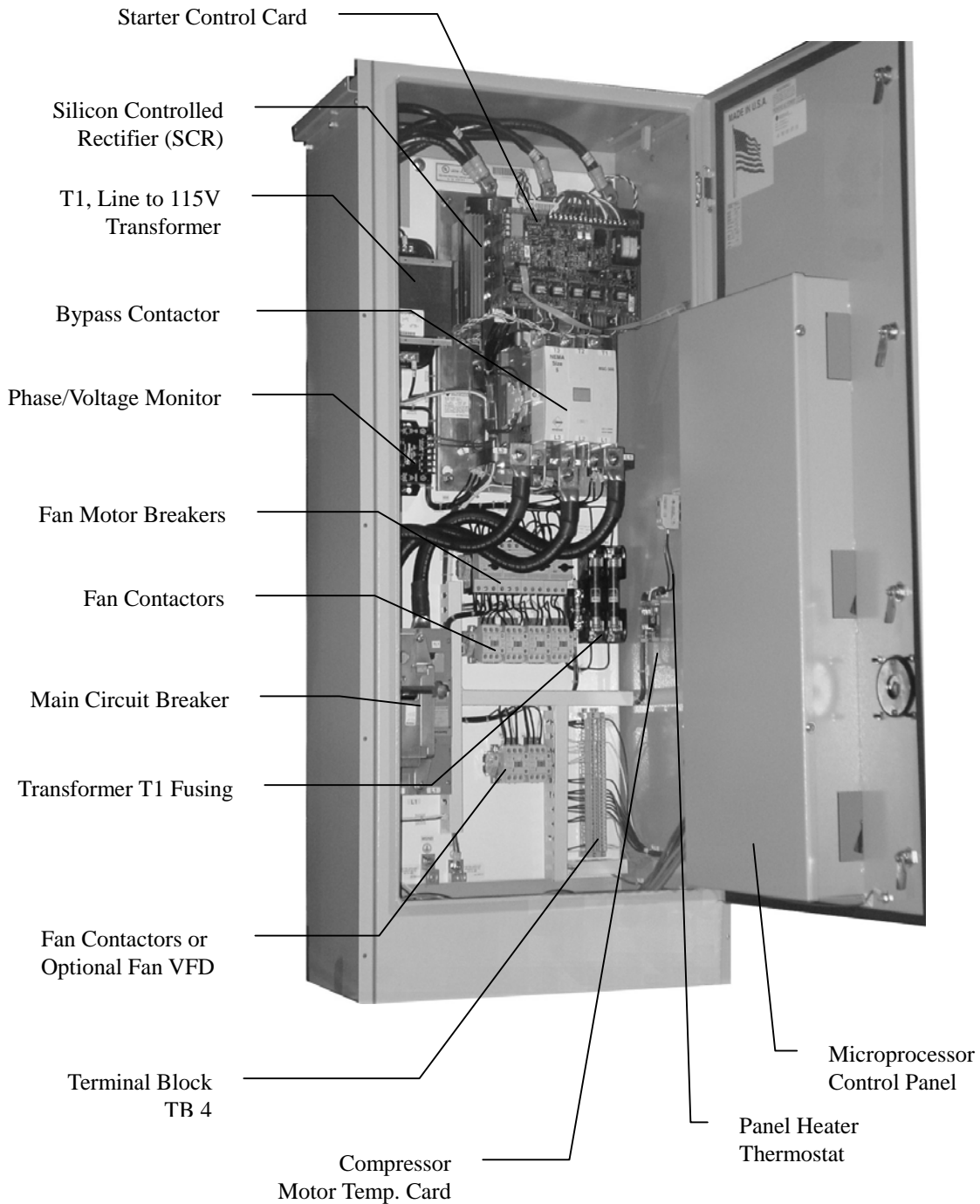


SENSOR LOCATION CHART			
SENSOR NUMBER	DESCRIPTION	SENSOR NUMBER	DESCRIPTION
S01	EVAP. PRESS. TRANSDUCER	S06	LIQUID LINE TEMPERATURE
S02	DISCH. PRESS. TRANSDUCER	S07	OUTSIDE AIR TEMPERATURE
S03	LIQUID PRESS. TRANSDUCER	S08	EVAP. LEAVING WATER TEMP.
S04	SUCTION TEMPERATURE	S09	EVAP. ENTERING WATER TEMP.
S05	DISCHARGE TEMPERATURE		

NOTE: The above diagram illustrates one circuit of an AGS chiller. Models AGS 230 to 320 have two similar circuits, Models AGS 340 to 475 have three such circuits. The evaporator is partitioned vertically into two or three refrigerant compartments with the water-filled tubes running from end to end.

Power Panel

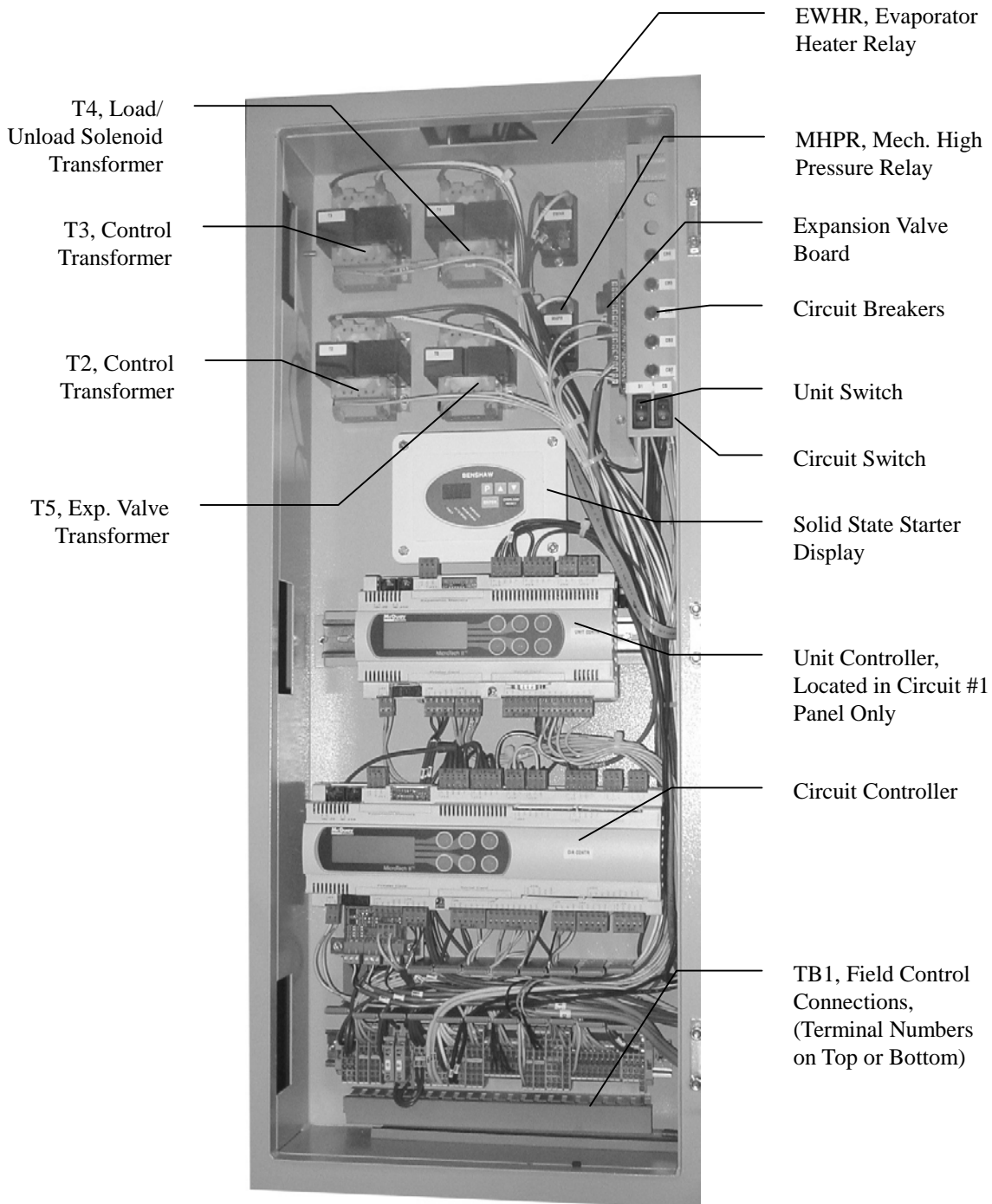
Each compressor and its associated refrigerant circuit and controlled devices have a dedicated power and control system. They are contained in a duplex panel, the outer box containing the MicroTech II microprocessor with related accessories and the inner box containing the power components including the starter.



Control Panel

The control panel for Circuit #1 is shown below. The panel for circuit #2 and #3 is similar but does not contain the Unit Controller.

Distributed control architecture enhances unit reliability. Each compressor circuit has its own microprocessor controller so that if one controller is inoperative, the other compressor(s) will be allowed to run.



Optional Features

There are a number of options that may or may not be present on any specific unit. These options can affect unit control operation and how a unit is installed and wired.

Controls

Low Ambient Head Pressure Control

Optional VFD head pressure control on first two fans permits unit operation down to 0°F (-18°C) ambient (balance of fans are staged on and off). However, since the actual minimum ambient can be dependent on wind conditions, wind baffles are also available. Selection of this option also requires the addition of the High Ambient Option to provide a heat dissipation means for the VFDs.

Ice Storage

The unit is equipped with control logic to handle the low temperatures associated with thermal storage applications. Additional evaporator insulation is recommended.

Water Flow Switch

(Part Number 01750330) A water flow switch is available for field installation in the chilled water piping to protect against evaporator freeze-up under low or no flow conditions. Terminals are provided in the control center for circuit #1 for field wiring of the water flow switch to the unit. **NOTE:** Installation of a flow detection device is required.

High Ambient Operation

Option required for operation at ambient temperatures above 115°F (46°C) or when the unit is equipped with the VFD low ambient fan control option. The kit includes a thermostat controlled, panel ventilation fan and inlet grille with filter. The option can be ordered with any unit. Ordering a “High Efficiency” unit does not automatically include this kit, it must be ordered separately. Compressor loading and unloading is adaptively determined by system load, ambient air temperature and other inputs to the MicroTech II control algorithms.

Building Automation System (BAS) Interface

This is the Protocol Selectability® option to the MicroTech II controller. The addition of this optional communications module to the standard unit controller enables the controller to communicate using standard protocols such as LONTALK®, Modbus® and BACnet® using any of the following data link layer options: BACnet MS/TP, BACnet/IP, BACnet Ethernet or LONTALK (FTT-10A). It is necessary to identify the data link layer that will be used when entering an order. The communications module can also be added later in the field to an existing controller.

Alarm Bell

Field installed and wired to the control panel to provide remote.

Electrical

Single-Point Power Block

A single power supply to a power block mounted in a box located on the unit's frame. Each circuit is factory-wired from the box to a power block in each circuit's power panel. See dimension drawings for the box location. Includes factory wiring to a circuit breaker located in each circuit's power panel. Multiple-point power block (one circuit per compressor) is standard.

Multi-Point w/Disconnect Switch

Separate power supply to each circuit's power panel which is equipped with a disconnect switch with a through-the-door handle. Each disconnect switch can isolate its circuit for service purposes.

Single-Point w/ Disconnect Switch

Single power supply to a factory-mounted disconnect switch. Includes factory wiring to a circuit breaker located in each circuit's power panel.

High- Short Circuit Current Protection

The control panels and single point connection box (if ordered) will have the high short circuit current rating as shown below. A high interrupt circuit breaker is included.

115 Volt Convenience Outlet

A 10.0 amp, 115-volt convenience outlet mounted inside the control panel is available as an option on all units. The outlet is located in the #2 circuit control box.

Lightning Arrestor per Compressor

Unit

Protective Base Guards

Optional factory installed wire mesh lower base guards provide protection for ground level installations. Coil guards are standard.

Wind Baffles/Hail Guard

The presence of wind will have an adverse affect on any air-cooled chiller. Wind across a condenser coil will not allow a chiller to operate as efficiently, or possibly not even start, at low ambient temperatures. Wind in effect raises the minimum ambient temperature in which the chiller can operate. The AGS air-cooled chillers are available with field installed wind baffles which allow the chiller to operate effectively down to the ambient temperature for which it was designed.

Hail can have a damaging effect on the performance of an air-cooled condenser. As the finned area is flattened against the coil, restricting airflow, the efficiency of the coil is reduced.

If desired, the wind/hail guards can be purchased for only one side of a unit in cases where an adjacent wall provides protection.

Louvers

Stamped metal louvers for the coil section (upper part of unit) or combined with lower louvers to cover the full height of the side of the unit, for field installation. They provide protection from hail and vandalism and add a decorative appearance to the unit.

Vibration Isolators

Spring vibration isolators are available for field installation under the unit base frame on sound sensitive applications. Consult the local McQuay sales office for seismic isolation.

Evaporator Insulation

Double evaporator thermal insulation is available and recommended for low fluid temperature applications.

Suction Butterfly Valve

An optional factory-mounted suction butterfly shutoff valve is available to assist in isolating the compressor for service.

Start-up and Shutdown

NOTICE

**McQuayService personnel or factory authorized service agency
must perform initial start-up in order to activate warranty.**



CAUTION

Most relays and terminals in the unit control center are powered when S1 is closed and the control circuit disconnect is on. Therefore, do not close S1 until ready for start-up or the unit may start unintentionally.

Switches

There is a single *unit* on-off switch, S1, located in the control box for circuit #1. S1 will cause a rapid shutdown, without pumpdown, when opened. The circuit #1 box and all other control boxes also have a *circuit* switch, CS, which will put the circuit into pumpdown when put in the open position. The (1) on the switch is on and the (0) is off.

Seasonal Start-up

1. Double check that the optional compressor suction butterfly valve is open.
2. Check that the manual liquid-line shutoff valves at the outlet of the subcooler coils are open.
3. Check the leaving chilled water temperature setpoint on the MicroTech II controller to be sure it is set at the desired chilled water temperature.
4. Start the auxiliary equipment for the installation by turning on the time clock, and/or remote on/off switch, and chilled water pump.
5. Check to see that circuit switches, CS, are in the off position. Put the unit switch, S1, in the on position.
6. Under the "Control Mode" menu of the keypad, place the unit into the automatic cool mode.
7. Start the system by placing the circuit #1 pumpdown switch CS in the on position.
8. Repeat step 7 for the balance of the circuits.

Temporary Shutdown

Move pumpdown switches CS to the off position. After the compressors have pumped down, turn off the chilled water pump.



CAUTION

Do not turn the unit off using the "S1" switch, without first moving PS1 and PS2 to the off position, unless it is an emergency, as this will prevent the unit from going through a proper shutdown/pumpdown sequence.



CAUTION

The unit has a one-time pumpdown operation. When the CS switches are in the off position the unit will pumpdown once and not run again until the switches are moved to the on position. If the CS switches are in the on position and the load has been satisfied, the unit will go into one-time pumpdown and will remain off until the MicroTech II control senses a call for cooling and starts the circuit. Under no circumstance use the compressors for pumpdown of the system with the liquid line valves closed.



CAUTION

It is important that the water flow to the unit is not interrupted before the compressors pump down to avoid freeze-up in the evaporator.



CAUTION

If all power is turned off to the unit, the compressor heaters will become inoperable. Once power is resumed to the unit, it is important that the compressor and oil separator heaters are energized a minimum of 12 hours before attempting to start the unit. Failure to do so could damage the compressors due to excessive accumulation of liquid in the compressor.

Start-up After Temporary Shutdown

1. Insure that the compressor heaters have been energized for at least 12 hours prior to starting the unit.
2. Start the chilled water pump.
3. With system switch S1 in the "on" position, move the circuit pumpdown switches CS to the on position.
4. Observe the unit operation until the system has stabilized.

Extended (Seasonal) Shutdown

1. Move the CS switches to the off position.
2. After the compressors have pumped down, turn off the chilled water pump.
3. Turn off all power to the unit and to the chilled water pump.
4. If fluid is left in the evaporator, confirm that the evaporator heaters are operational.
5. Move the emergency stop switch S1 to the off position.
6. Close the optional compressor suction valve (if so equipped) as well as the liquid line shutoff valves.
7. Tag all opened compressor disconnect switches to warn against start-up before opening the compressor suction valve and liquid line shutoff valves.
8. If glycol is not used in the system, drain all water from the unit evaporator and chilled water piping if the unit is to be shutdown during winter and temperatures below -20°F can be expected. The evaporator is equipped with heaters to help protect it down to -20°F. Chilled water piping must be protected with field installed protection. Do not leave the vessels or piping open to the atmosphere over the shutdown period.
9. Do not apply power to the evaporator heaters if the system is drained of fluids as this can cause the heaters to burn out.

Start-up After Extended (Seasonal) Shutdown

1. With all electrical disconnects locked and tagged open, check all screw or lug-type electrical connections to be sure they are tight for good electrical contact.
2. Check the voltage of the unit power supply and see that it is within the $\pm 10\%$ tolerance that is allowed. Voltage unbalance *between* phases must be within $\pm 2\%$.
3. See that all auxiliary control equipment is operative and that an adequate cooling load is available for start-up.
4. Check all compressor flange connections for tightness to avoid refrigerant loss. Always replace valve seal caps.
5. Make sure system switch S1 is in the off position and circuit pumpdown switches, CS, are set to the off position. Place the main power and control disconnect switches to on. This will energize the crankcase heaters. Wait a minimum of 12 hours before starting up unit. Turn compressor circuit breakers to "off" position until ready to start unit.
6. Open the optional compressor suction butterfly as well as the liquid line shutoff valves.
7. Vent the air from the evaporator water side as well as from the system piping. Open all water flow valves and start the chilled water pump. Check all piping for leaks and recheck for air in the system. Verify the correct flow rate by taking the pressure drop across the evaporator and checking the pressure drop curves in the installation manual, IMM AGS
8. The following table gives glycol concentrations required for freeze protection.

Table 30, Freeze Protection

Temperature °F (°C)	Percent Volume Glycol Concentration Required			
	For Freeze Protection		For Burst Protection	
	Ethylene Glycol	Propylene Glycol	Ethylene Glycol	Propylene Glycol
20 (6.7)	16	18	11	12
10 (-12.2)	25	29	17	20
0 (-17.8)	33	36	22	24
-10 (-23.3)	39	42	26	28
-20 (-28.9)	44	46	30	30
-30 (-34.4)	48	50	30	33
-40 (-40.0)	52	54	30	35
-50 (-45.6)	56	57	30	35
-60 (-51.1)	60	60	30	35

Notes:

1. These figures are examples only and cannot be appropriate to every situation. Generally, for an extended margin of protection, select a temperature at least 10°F lower than the expected lowest ambient temperature. Inhibitor levels should be adjusted for solutions less than 25% glycol.
2. Glycol of less than 25% concentration is not recommended because of the potential for bacterial growth and loss of heat transfer efficiency.

System Maintenance

General

On initial start-up and periodically during operation, it will be necessary to perform certain routine service checks. Among these are checking the liquid line sight glasses, evaporator sight glasses, and oil separator sight glasses, plus taking a full set of refrigerant pressure and temperature readings. Through the MicroTech II keypad, check to see that the unit has normal superheat and subcooling readings. A recommended maintenance schedule is located at the end of this section.

A Periodic Maintenance Log is located at the end of this manual. It is suggested that the log be copied and a report be completed on a regular basis. The log will serve as a useful tool for a service technician in the event service is required.

Initial start-up data including evaporator pressure drop, vibration readings, compressor megger readings and oil analysis information should be kept for reference base-line data.

Compressor Maintenance

Since the compressor is semi-hermetic, no yearly compressor maintenance is normally required, however, vibration is an excellent check for proper mechanical operation. Compressor vibration is an indicator of the requirement for maintenance and contributes to a decrease in unit performance and efficiency. It is recommended that the compressor be checked with a vibration analyzer at, or shortly after, start-up and again on an annual basis. The load should be maintained as closely as possible to the load of the original test. The initial vibration analyzer test provides a benchmark of the compressor, and when performed routinely, can give a warning of impending problems.

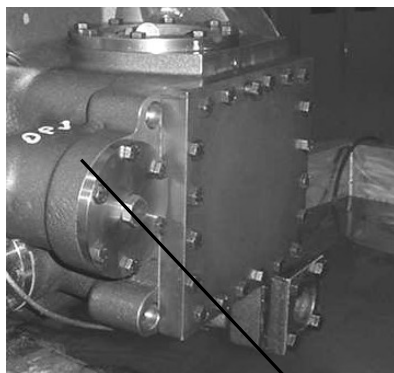
Lubrication

No routine lubrication is required on AGS units. The fan motor bearings are permanently lubricated. No further lubrication is required. Excessive fan motor bearing noise is an indication of a potential bearing failure.

Compressor oil must be ICI RL68HP, McQuay Part Number 735030442 in a 1-gallon container, or ICI RL68H, Part Number 735030444 in a 1-gallon size. This is synthetic polyolester oil with anti-wear additives and is highly hygroscopic. Care must be taken to minimize exposure of the oil to air when charging oil into the system.

On early units, an oil filter is located in the oil return line from the oil separator to the compressor.

Figure 31, Compressor Oil Filter



On later units, the oil filter resides in the compressor housing as shown in Figure 31. Units without a suction service shutoff valve require pumping down the circuit in order to change the filter.

This filter should be replaced after one month of operation or if the pressure drop exceeds 7 psi (48 kPa) as measured at Schrader fittings up and down stream from the filter.

Oil Filter Housing

Electrical Terminals



DANGER

Electric shock hazard and risk of personal injury or death exists. Turn off all power before continuing with following service.

Periodically check electrical terminals for tightness and tighten as required.

Condensers

The condensers are air-cooled and constructed of 3/8" (9.5mm) OD internally finned copper tubes bonded in a staggered pattern into louvered aluminum (standard material) fins. No maintenance is ordinarily required except the routine removal of dirt and debris from the outside surface of the fins. McQuay recommends the use of foaming coil cleaners available at most air conditioning supply outlets.



WARNING

Use caution when applying such coil cleaners as they can contain potentially harmful chemicals. Breathing apparatus and protective clothing should be worn. Thoroughly rinse all surfaces to remove any cleaner residue. Care should be taken not to damage the fins during cleaning.

If the service technician has reason to believe that the refrigerant circuit contains noncondensables, recovery of the noncondensables can be required, strictly following Clean Air Act regulations governing refrigerant discharge to the atmosphere. The service Schrader valves are located on both vertical coil headers on both sides of the unit at the control box end of the coil. Access panels are located at the end of the condenser coil directly behind the control panel. Recover the noncondensables with the unit off, after shutdown of 15 minutes or longer, to allow air to collect at the top of the coil. Restart and run the unit for a brief period. If necessary, shut the unit off and repeat the procedure. Follow accepted environmentally sound practices when removing refrigerant from the unit.

Liquid Line Sight Glass

The AGS-B chiller electronic expansion valve, under normal operation, is controlled by maintaining a calculated liquid line subcooling value. The EXV control, if the circuit is in subcooling control, will vary the subcooling from 2 to 20 degrees F (1 to 11 degrees C) or greater, depending upon operating conditions. If the circuit is operating in subcool control, the liquid line sight glasses will not be an indication of charge amount. This is due to the chiller controlling the liquid subcooling at that location. Calibration of the liquid line pressure transducer and thermistor is required for proper control. An improper calibration may cause the liquid line sight glass to flash due to false subcooling calculation.

On startup and during other operating conditions such as high LWT and ICE mode, the expansion valve control will be in pressure control. If the circuit is in pressure control, a flashing liquid line sight glass may be an indication of low refrigerant. The chiller will not go to subcooling control if the subcooling is not equal to the calculated subcooling target for the operating conditions while in pressure control. A flashing sight glass, while in pressure control, may indicate excessive pressure drop in the liquid line, possibly due to a clogged filter-drier or a restriction elsewhere in the liquid line (see Table 31 on page 61 for maximum allowable pressure drops).

NOTE: Exceeding normal charge can result in abnormally high discharge pressure and relief valve discharge, or cause low discharge superheat resulting in oil loss into the system.

An element inside the sight glass indicates the moisture condition corresponding to a given element color. The color code is printed on the edge of the sight glass. If the sight glass does not indicate a dry condition after about 12 hours of operation, the circuit should be pumped down and the filter-drier changed. An oil acid test is also recommended.

Evaporator Sight Glass

There are evaporator sight glasses on the side of the evaporator barrel, 1 for each circuit, located approximately half way up the vessel. The evaporator sight glasses are for reference use only. The electronic expansion valve control algorithms vary with operating conditions and will cause a higher or lower liquid level in the evaporator. You can use the sight glasses to give you some relative decision making information. If there is a considerable amount of oil out in the system, you may see oil floating on the evaporator liquid level, the refrigerant may have a yellowish tint or you may see an oil film on the sight glass as the liquid level rises and falls. Oil in the evaporator is often an indication of too much oil in the circuit, or the circuit is running low discharge superheat. Oil will also increase the evaporator approach value above normal. For refrigerant charge while in subcooling control, typically half of a sight glass full is normal. A full sight glass with low discharge superheat, is a good indication of too much refrigerant charge. An empty sight glass, with low pressure unload and trip events, is a good indication of insufficient refrigerant charge.

Lead-Lag

A feature on all McQuay AGS air-cooled chillers is a system for alternating the sequence in which the compressors start to balance the number of starts and run hours. Lead-Lag of the refrigerant circuits is accomplished automatically through the MicroTech II controller. When in the auto mode, the circuit with the fewest number of starts will be started first. If all circuits are operating and a stage off in the number of operating compressors is required, the circuit with the most operating hours will cycle off first. The operator can override the MicroTech II controller, and manually select the lead circuit as circuit #1, #2, or #3.

Preventative Maintenance Schedule

PREVENTATIVE MAINTENANCE SCHEDULE			
OPERATION	WEEKLY	MONTHLY (Note 1)	ANNUAL (Note 2)
General			
Complete unit log and review (Note 3)	X		
Visually inspect unit for loose or damaged components and visible leaks		X	
Inspect thermal insulation for integrity			X
Clean and paint as required			X
Electrical			
Sequence test controls			X
Check contactors for pitting, replace as required			X
Check terminals for tightness, tighten as necessary			X
Clean control panel interior			X
Visually inspect components for signs of overheating		X	
Verify compressor and oil heater operation		X	
Megger compressor motor			X
Refrigeration			
Leak test		X	
Check sight glasses for clear flow	X		
Check filter-drier pressure drop (see manual for spec)		X	
Check oil filter pressure drop (Note 6)		X	
Perform compressor vibration test			X
Perform acid test on compressor oil			X
Condenser (air-cooled)			
Clean condenser coils (Note 4)			X
Check fan blades for tightness on shaft (Note 5)			X
Check fans for loose rivets and cracks, check motor brackets			X
Check coil fins for damage and straighten as necessary			X

Notes:

1. Monthly operations include all weekly operations.
2. Annual (or spring start-up) operations include all weekly and monthly operations.
3. Log readings can be taken daily for a higher level of unit observation.
4. Coil cleaning can be required more frequently in areas with a high level of airborne particles.
5. Be sure fan motors are electrically locked out.
6. Replace the filter after first month of operation, thereafter replace the filter if pressure drop exceeds Table 31 pressure levels.

Warranty Statement

Limited Warranty

Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.



CAUTION

1. Service on this equipment is to be performed by qualified refrigeration personnel familiar with equipment operation, maintenance, correct servicing procedures, and the safety hazards inherent in this work. Causes for repeated tripping of equipment protection controls must be investigated and corrected.
 2. Anyone servicing this equipment must comply with the requirements set forth by the EPA regarding refrigerant reclamation and venting.
-



DANGER

Disconnect all power before doing any service inside the unit to avoid bodily injury or death. Multiple power sources can feed the unit.

Liquid Line Filter-Driers

A replacement of the filter-drier cores is recommended any time excessive pressure drop is read across the filter-drier and/or when bubbles occur in the sight glass with normal subcooling. There are two two-core driers in each circuit. The maximum recommended pressure drop across the filter-drier is as follows:

Table 31, Liquid Line Filter-Drier Pressure Drop

Percent Circuit Loading (%)	Maximum Recommended Pressure Drop Across Filter Drier psig (kPa)
100%	7 (48.3)
75%	5 (34.5)
50%	3 (20.7)
25%	3 (20.7)

Change the filter-driers when the moisture indicating liquid line sight glass indicates excess moisture in the system, or an oil test indicates the presence of acid.

During the first few months of operation, filter-drier replacement can be necessary if the pressure drop across the filter-drier exceeds the values listed in the table above. Any residual particles from the condenser tubing, compressor and miscellaneous components are swept by the refrigerant into the liquid line and are caught by the filter-drier.

The following is the procedure for changing the filter-drier core:

The standard unit pumpdown is set to stop pumpdown when 25 psig (172 kPa) suction pressure is reached. To fully pump down a circuit beyond 25 psig (172 kPa) for service purposes, a "Full Pumpdown" service mode can be activated on the circuit controller using the keypad.

With Full Pumpdown = Yes, then the next time the circuit is pumped down, the pumpdown will continue until the evaporator pressure reaches 15 psig (103 kPa) or 120 seconds have elapsed, whichever occurs first. Upon completing the pumpdown, the "FullPumpDwn" setpoint is automatically changed back to "No".

The procedure to perform a full service pumpdown for changing the filter-drier core is as follows:

1. On the circuit controller, under the "SET EXV SPs (2)", change the "Service Pumpdown" set point from "No" to "Yes".
2. If the circuit status is "Off:PumpDwnSw", move the circuit pumpdown switch from "Pumpdown and Stop" to "Auto". Also clear the anticycle timers through the MicroTech keypad.
3. Move the circuit switch to the OFF position. The compressor will unload to minimum slide position and the unit will pump down.
4. Upon completing the full pumpdown per step 3, the "Service Pumpdown" setpoint is automatically changed back to "No" which reverts back to standard 25 psig (172 kPa) pumpdown stop pressure.
5. If the pumpdown does not go to 15 psig (103 kPa) on the first attempt, one more attempt can be made by repeating the above steps. Do not repeat "Service Pumpdown" more than once to avoid excessive screw temperature rise under this abnormal condition.
6. The circuit is now in the deepest pumpdown that can be achieved by the use of the compressor. Close the two liquid line shutoff valves upstream of the filter-drier, on the circuit to be serviced plus the optional suction shutoff valve. Manually open the EXV, then pump the remaining refrigerant from the evaporator. Any remaining refrigerant must be removed from the circuit by the use of a refrigerant recovery unit.
7. Loosen the cover bolts, remove the cap and replace the filters.
8. Evacuate and open valves.

Evacuate the lines through the liquid line manual shutoff valve(s) to remove noncondensables that can have entered during filter replacement. A leak check is recommended before returning the unit to operation.

Compressor Slide Valves

The slide valves used for unloading the compressor are hydraulically actuated by pulses from the load/unload solenoid as controlled by the circuit controller. See OM AGS for details on the operation.

Electronic Expansion Valve

The electronic expansion valve is located in the liquid line entering the evaporator.

The expansion valve meters the amount of refrigerant entering the evaporator to match the cooling load. It does this by maintaining constant condenser subcooling. (Subcooling is the difference between the actual refrigerant temperature of the liquid as it leaves the condenser and the saturation temperature corresponding to the liquid line pressure.) All AGS chillers are factory set at 20 degrees F subcooling at 100% slide position and approximately 5 degrees F subcooling at minimum slide position. The controller will offset these settings based on discharge superheat.

When the control panel is first powered, the microprocessor will automatically step the valve to the fully closed (shut) position. The valve will take approximately 30 seconds to go from a full open position to a full closed position.

The position of the valve can be viewed at any time by using the MicroTech II controller keypad through the View Refrigerant menus. There are 6386 steps between closed and full open. There is also a sight glass on the EXV to observe valve movement.

Evaporator

The evaporator is a flooded, shell-and-tube type with water flowing through the tubes and refrigerant flowing up the shell over the tubes. The tubes are internally enhanced to provide

extended surface and turbulent flow of water through the tubes. Normally no service work is required on the evaporator other than cleaning the water (tube) side in the event of improper water treatment or contamination.

Charging Refrigerant

Why does the AGS flooded evaporator use subcooling control?

Subcool control maintains proper evaporator level for efficiency and is the most stable value with which to control a flooded evaporator chiller. Discharge superheat control is affected by many variables such as motor heat, refrigerant flow, number of fans operating, amount of refrigerant in the oil, etc. Additionally, the chiller cannot be controlled by the traditional suction superheat control due to the saturated refrigerant entering the suction cooled motor. Often this is a heavily saturated vapor that helps cool the motor and is not suitable for flow control purposes.

Do not use the evaporator sight glasses to charge the unit.

Each circuit of the evaporator has a sight glass located on the side, halfway up and adjacent to the internal tube sheet. There should be refrigerant level viewable in each circuit. A low level combined with low evaporator pressure indicated by a LowEvapPressHold alarm indicates a low refrigerant charge for the circuit.

Use these sight glasses for reference only. The expansion valve control varies with operating conditions and may cause a higher or lower level based on control decisions. The sight glasses can give you some relative information for decision making. If there is a considerable amount of oil in the system, you may see oil floating on the evaporator liquid level and/or oil smearing on the sight glass as the liquid level rises and falls.

Discharge superheat

The most important value to monitor while setting the charge on an AGS flooded evaporator chiller is the discharge superheat (DSH), and especially at full load. Between 20 and 22 degrees F (11 and 12 degrees C) DSH, the compressor will hold its slide target and will not load up. If the DSH drops below 20 degrees F (11 degrees C), it will unload. Excessive refrigerant charge, excessive oil, a large amount of oil in circulation and a leaking or over feeding evaporator solenoid valve will all cause low discharge superheat.

Approach temperatures:

Oil in the system will affect the condenser and evaporator approach temperatures. The design approach (saturated discharge temperature minus ambient air temperature) on the condenser at full load is 30 to 35 degrees F (16 to 19 degrees C). The evaporator approach should be 3 to 10 degrees F (1.6 to 5.5 degrees C), depending on conditions and percent of glycol, if used.

Oil in evaporator:

Oil in the evaporator will float on the liquid refrigerant and get pulled out with suction gas, carrying liquid refrigerant with it and reducing the discharge superheat. The goal is to keep the discharge superheat above 22 degrees F (12 degrees C), and ideally at 35 degrees F (19 degrees C), while trying to get the compressor loaded up. The higher the refrigerant flow, the quicker the oil will be recovered.

Evaporator Oil Return Line:

In some applications, the evaporator oil return line can cause low discharge superheat and some oil loss into the system. It may be necessary to reduce the flow through the evaporator

oil return line by incrementally closing down the ball valve. This can help maintain oil in the oil separator and higher DSH, if it is overfeeding and dropping the DSH too much. The minimum superheat the control will allow is 35 degrees F (19 degrees C) to help ensure that the DSH does not cause issues with limiting the compressor with low discharge superheat or cause oil loss. Most of the oil recovery is done through carry-over through the suction line. The evaporator oil return line is used more effectively for discharge temperature control, and a by-product is that a small percentage of oil will be recovered.

Basic Charging Information:

Determine the following:

1. What control mode is the EXV in?
2. What is the circuit status?
3. What is the compressor slide position?
4. What is the DSH at 100% load?
5. What is the suction pressure at 100% load?
6. Is the evaporator oil return line (EORL) solenoid on?
7. What is the outdoor air temperature (OAT) and how many fans are on?
8. How does the discharge superheat compare to Figure 32 on page 65.

Details to Consider:

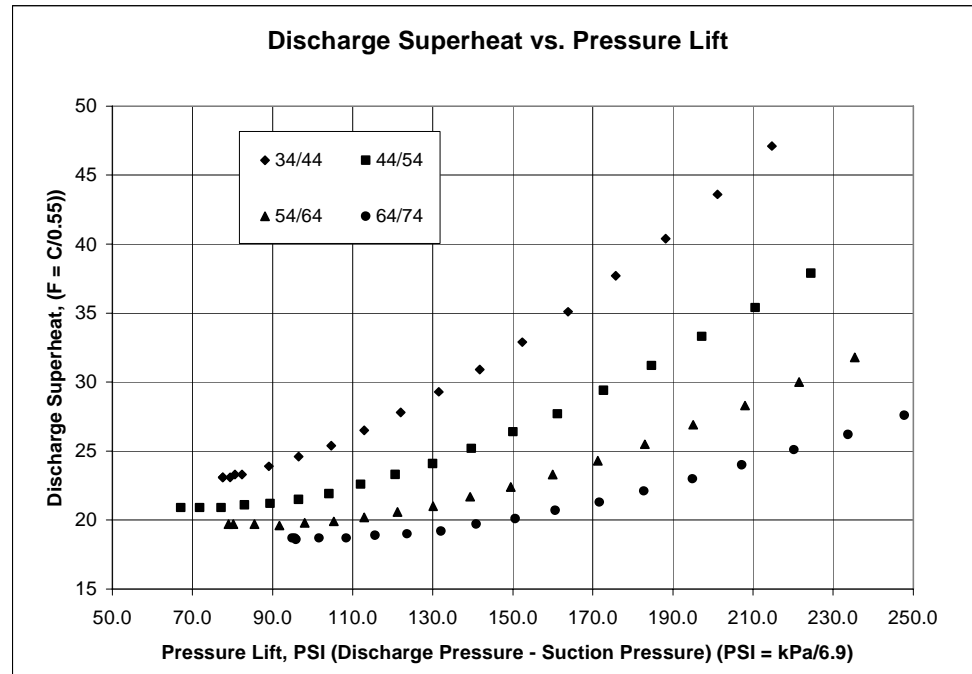
1. The unit must be in Subcool control before being able to fine-tune the charge. If the unit has insufficient subcooling, it will not convert to Subcool control. At 100% load there must be a minimum of 20 degrees F (11 degrees C) of liquid line subcooling before the circuit will allow subcooling control, therefore you may need to add charge to get to this point in the case of severely undercharged units.
2. Verify that the circuit is not limited on a capacity limit or inhibit event. Limitation of the chiller on low DSH, high lift, or low evaporator pressure may be clues to help determine a refrigerant or oil charging issue.
3. It is hard to determine proper charge amounts while at part loads. For best charging results the slide target should be at 100%. If there is a significant over or under charge you may have to make adjustments to get the compressor to full load. It may be necessary to revisit a unit when it would be at full load, to check and fine tune the charge. Sequentially shutting off all but one circuit may provide a full load on the remaining circuit.
4. In order to maintain oil integrity, the discharge superheat needs to be greater than 20 degrees F (11 degrees C). The compressor will unload below this value. Between 20 and 22 degrees F (11 and 12 degrees C) DSH, the compressor will not load up and will be in a low discharge superheat inhibit event. At high refrigerant flows, more liquid carry-over will occur and the DSH will be lower. This means the compressor will have to be at 100% to set up the refrigerant charge correctly.
5. Typically the suction pressure will be near the Low PressureHold setpoint while at full load. You may need to sacrifice some suction pressure by removing some refrigerant to get the discharge superheat up.
6. See above note on evaporator oil return line.
7. The lower the OAT, and the lower the saturated condensing temperature is, the more refrigerant flow there will be, increasing the possibility of more liquid carry over from the evaporator.
8. Use Figure 32, Discharge Superheat vs. Pressure Lift chart to verify charge. For a given lift, superheat above the curve indicates low charge, below indicates high charge.

Summary:

At 100% slide position, in Subcool control, the DSH should be as high as possible with suction pressure at a operable value based on water/glycol mixture. At 100% load, in Subcool control, the DSH and suction pressure need to be balanced.

Example: Running circuit 1 at 100% slide target, with water only in the loop, set the low evaporator pressure unload to 28psi (32°sat.) and the low evaporator pressure hold to 30psi. Run the suction pressure at approximately 32psi at full load. This should allow room for 25-30° DSH. As a rule of thumb, as outdoor air temperature drops, it becomes more difficult to maintain minimum DSH with a given charge amount, due to higher refrigerant flows.

**Figure 32, Discharge Superheat vs. Pressure Lift at Full Circuit Load
For Various Chilled Water Temperatures**



Discharge superheat is directly related to the amount of liquid carried from the evaporator and amount of motor heat rejected into the refrigerant.

Higher pressure lifts will result in higher discharge superheats.

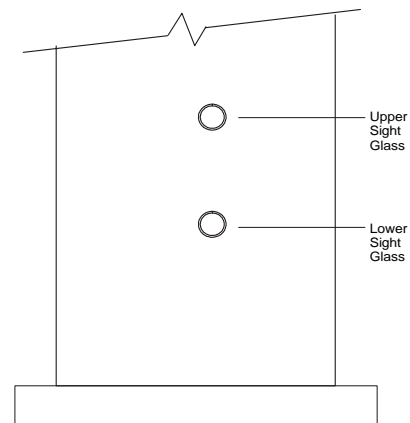
More liquid carry over will result in lower discharge superheats, less liquid carry over will result in higher discharge superheats.

More liquid carry over will occur when:

1. The refrigerant circuit is overcharged.
2. Excessive oil is in the evaporator.
3. Mass flow rate of compressor is increased.
4. Oil return solenoid is energized or leaking (more liquid injection than oil return).
5. Evaporator tubes fouled or are plugged.

Charging Oil

The oil separator is equipped with two sight glasses that are used to indicate oil quantity. Oil charge determination must be done at, or near, full load. It may be normal to see the oil below the bottom sight glass while running at part load conditions due to oil laying in the compressor casting at low refrigerant flows. However, oil trips at part load indicate low oil level. While operating at full load with a proper oil charge in a circuit, the bottom sight glass should show full with some movement of bubbles, the top sight glass should appear full but there should be a violent show of bubbles.



If the separator has too much oil while at full load, both sight glasses will be clear (level above the upper sight glass) and may exhibit some bubbling in the top sight glass. If the circuit has too much oil, the circuit may be limited on low discharge superheat, low suction pressure, high evaporator approach, and/or high condenser approach due to an excessive amount of oil out in the system. If the oil separator is low on oil there will be visible levels in one or both sight glasses (this tends to be a collection of oil in sight glasses as the oil travels down the sides of the vessel during the separation process). Low oil trips in the Event (1 time trip) and Alarm buffers (2 trips in 60 minutes) may indicate low oil charge, or operation with low discharge superheat due to over charging oil or over charging refrigerant.

If it is determined that oil should be added to a circuit, the oil should be pumped in at the backseat port on the service valve either on the top of the oil separator barrel or at the service valve on the oil line exiting the oil separator. It may be necessary to shut the circuit off to reduce the pressure in the oil separator to make it easier to pump oil in to the separator.

Compressor oil must be ICI RL68HP, McQuay Part Number 735030442 in a 1 gallon container, or ICI RL68H, Part Number 735030444 in a 1 gallon container.

NOTE

Unit operation with low discharge superheat due to excessive oil or excessive refrigerant charge can cause poor oil separation in the oil separator and the subsequent coating of heat transfer surfaces, which will reduce unit performance and limit unit operating range.

Standard Controls

NOTE: A complete explanation of the MicroTech II controller and unit operation is contained in the Operation Manual OM AGS.

Thermistor sensors

Evaporator leaving water temperature - This sensor is located on the evaporator water outlet connection and is used for capacity control of the chiller and low water temperature freeze protection.

Evaporator entering water temperature - This sensor is located on the evaporator water inlet connection and is used for monitoring purposes and return water temperature reset control.

Evaporator pressure transducer circuit #1, 2 (and 3) - This sensor is located on the suction side of the compressor and is used to determine saturated suction refrigerant pressure and temperature. It also provides low pressure freeze protection.

Condenser pressure transducer circuit #1, 2 (and 3) - the sensor is located on the discharge of the oil separator and is used to read pressure and saturated refrigerant temperature. The transducer will unload the compressor if a rise in head pressure occurs which is outside the MicroTech II controller setpoint limits. The signal is also used in the calculation of discharge superheat.

Liquid pressure transducer #1, 2 (and 3) – located on the liquid line ahead of the EXV. It is used to determine liquid pressure and subcooling and is used to control the EXV.

Outside air - This sensor is located on the back of the control box on compressor #1 side. It measures the outside air temperature, is used to determine if low ambient start logic is necessary and can be the reference for low ambient temperature lockout.

Suction temperature circuit #1, 2, (and 3) - The sensor is located in a well on the suction line. The purpose of the sensor is to measure refrigerant temperature and superheat.

Discharge line temperature circuit #1, 2 (and 3) - The sensor is located in a well on the discharge line. It measures the refrigerant temperature and is used to calculate discharge superheat.

Demand limit - This requires a field connection of a 4-20 milliamp DC signal from a building automation system. It will determine the maximum number of cooling stages that can be energized.

Evaporator water temperature reset - This requires a 4-20 milliamp DC signal from a building automation system or temperature transmitter to reset the leaving chilled water setpoint.

High condenser pressure control

The MicroTech II is equipped with a transducer in the high pressure side of each refrigerant circuit. This pressure value is converted to saturated condenser temperature for condenser fan staging and for limiting compressor capacity to keep the circuit within safe operating conditions. For a detailed description of condenser fan logic, see the unit operating manual, AGS OM-4 or later revision.

The high condenser pressure control operates according to a maximum allowable operating condenser pressure curve which is based on the saturated evaporator temperature(see the AGS OM for details). The circuit controller will display the calculated max saturated condenser temperature “MaxCondSatT” on the View Refrigerant (6) screen. At 5 degrees F (2.7 degrees C) saturated condenser temperature below the MaxCondSatT value, the chiller will be in a hold condition and will not allow the compressor to load up. At 3 degrees F (1.6 degrees C) below the MaxCondSatT the compressor will begin to unload to reduce the condenser pressure.

If the saturated condenser temperature exceeds the MaxCondSatT, it will shut down the compressor with no pumpdown and go into an OFF: Alarm state. At the time of the alarm the circuit data will be recorded in the Alarm buffer.

Mechanical high pressure equipment protection control

The high pressure equipment protection control is a single pole, pressure-activated switch that opens on a pressure rise. When the switch opens, the control circuit is de-energized, dropping power to the compressor and fan motor contactors. The switch is factory set (non-adjustable) to open at 310 psig (2137 kPa) ± 7 psig and reclose at 200 psig (1379 kPa) ± 7 psig. Although

the high pressure switch will close again at 200 psig (1379 kPa), the control circuit will remain locked out and it must be reset through the MicroTech II control.

The control is mounted in the control panel.

Compressor motor protection

The compressors are supplied with two types of motor protection. Solid state electronic overloads mounted in the control box sense motor current to within 2% of the operating amps. The MUST TRIP amps are equal to 140% of unit nameplate compressor RLA. The MUST HOLD amps are equal to 125% of unit nameplate RLA. A trip of these overloads can result from the unit operating outside of normal conditions. Repeat overload trips under normal operation can indicate wiring or compressor motor problems. The overloads are manual reset and must be reset at the overload as well as through the MicroTech II controller.

The compressors also have a solid state Guardistor® circuit that provides motor over temperature protection. The Guardistor® circuit has automatic reset and gives a Starter Fault (F75) that is cleared through the starter display and must also be reset through the MicroTech II control.

Head pressure control

The compressor must be running in order to stage its fans on.

Condenser pressure trim control is accomplished using a variable frequency drive (VFD) on the first two fans that turn on. This VFD control uses a proportional integral function to drive the saturated condenser temperature to a target value by changing the fan speed. The target value is normally the same as the saturated condenser temperature target setpoint.

The VFD will start the fans when the saturated condenser temperature goes above the temperature target. Once the VFD fans are on, they will not shut off until the saturated condenser temperature is less than the minimum saturated temperature plus 5 degrees F (2.7 degrees C).

Stage up Compensation

In order to create a smoother transition when another fan is staged on, the VFD compensates by slowing down initially. This is accomplished by adding the new fan stage up deadband to the VFD target. The higher target causes the VFD logic to decrease fan speed. Then, every 10 seconds, 0.5 degrees F (0.25 degrees C) is subtracted from the VFD target until it is equal to the saturated condenser temperature target setpoint. This will allow the VFD to slowly bring the saturated condenser temperature back down.

Condenser Target

This logic is only used with VFD = Yes in the controller set point screen. Most applications will benefit from using the factory default values. The AGSU30101F software version has two setpoints used to set a minimum(Min) and a maximum(Max) range for the saturated condenser target. This can be found on the circuit controller at Set Fan Sps(5). This allows for a floating condenser target based on saturated evaporator temperature. The default values of the minimum and maximum are both set to 110°F (43.3°C) saturated condensing temperature. This will normally provide the most stable unit operation. Adjusting the Min or Max setpoint at each circuit controller will vary the condenser target along a line determined by two points which are; 1) 85°F (29.4°C) saturated condenser and 20°F (6.7°C) saturated suction, and 2) 110°F (43.3°C) saturated condenser and 50°F (10.0°C) saturated suction. Note that the chiller system is designed for specific refrigerant flow capacities, which may be exceeded by decreasing the condenser target. The result will be at lower ambient temperatures, the chiller may attain the maximum unit tonnage capacities while compressor loading will be limited on low discharge superheat.

Fan Stages with VFD Option

The VFD option must always be enabled. The first two fans are controlled by the fan VFD. This leaves 6 stages of fan control available with 8 fan circuits, and 4 stages available on 6 fan

circuits. Although fans 5/6 and 7/8 are controlled by one contactor each, more stages are created by using virtual stages. See the table below:

Table 32, Staging with VFD

Stage	Fans On
1	1,2,3
2	1,2,3,4
3	1,2,4,5,6
4	1,2,3,4,5,6
5	1,2,3,5,6,7,8
6	1,2,3,4,5,6,7,8

Staging Up

There are four stage-up deadbands that apply to the fan control stages. Stages one through three use their respective deadbands. Stage four to eight share the fourth stage-up deadband.

When the saturated condenser temperature is above the Target + the active deadband, a Stage Up error is accumulated.

The saturated condenser temperature must not be falling for a Stage Up accumulation to occur.

Stage Up Error Step = Saturated Condenser Refrigerant temperature – (Target + Stage Up deadband)

The Stage Up Error Step is added to Stage Up Accumulator once every Stage Up Error Delay seconds. When Stage Up Error Accumulator is greater than the Stage Up Error Setpoint, another stage is added.

When a stage up occurs, or the saturated condenser temperature falls back within the Stage Up deadband, the Stage Up Accumulator is reset to zero.

Forced Fan Stage At Start

Fans may be started simultaneously with the compressor based on outdoor ambient temperature. When the compressor starts, a fan stage is forced, based on the following table.

Table 33, Forced Staging

Outside Air Temperature	Fan Stage At Start
> 75 °F	Forced FanTrol 1 Set Point
> 90 °F	Forced FanTrol 2 Set Point
> 105 °F	Forced FanTrol 3 Set Point

Staging Down

There are four Stage Down deadbands. Stages one through three use their respective deadbands. Stages four to eight share the fourth Stage Down deadband.

When the condenser saturated refrigerant temperature is below the Target – the active deadband, a Stage Down error is accumulated.

Stage Down Error Step = (Target – Stage Down deadband) – Saturated Condenser Refrigerant temperature

The Stage Down Error Step is added to Stage Down Accumulator once every Stage Down Error Delay seconds. When the Stage Down Error Accumulator is greater than the Stage Down Error Setpoint, another stage of condenser fans turned off.

When a stage down occurs, or the saturated temperature rises back within the Stage Down deadband, the Stage Down Error Accumulator is reset to zero. The accumulator is also held at zero after startup until either the outside ambient temperature is less than, or equal to 75°F (23.9°C), or the saturated condenser temperature is greater than the condenser target, less the active stage down deadband.

The head pressure control will provide proper operating refrigerant discharge pressures at the ambient temperatures listed for it, provided the coil is not affected by the existence of wind. Wind baffles must be utilized for low ambient operation if the unit is subjected to winds greater than 5 mph.

Low ambient start

Low ambient start is incorporated into the MicroTech II controller logic. The MicroTech II controller will measure the difference between freezestat and evaporator pressure and determine the length of time that the compressor will be allowed to run (to build up evaporator pressure) before taking the compressor off line. The danger of allowing the compressor to run for too long before building up evaporator pressure is that the evaporator could freeze.

Phase/voltage monitor

The phase/voltage monitor is a device that provides protection against motor loss due to power failure conditions, phase loss, and phase reversal. Whenever any of these conditions occur, a Normally Closed contact opens in the external fault circuit of the starter, generating a F75 fault code that then de-energizes all inputs. The F75 code is interrupted by the MicroTech II controller as an external fault and must be cleared through the MicroTech II control.

When proper power is restored, contacts close and the fault must be cleared through both the starter keypad and the MicroTech II control.

When three-phase power has been applied, the output relay should close and the "run light" should come on. If the output relay does not close, perform the following tests.

1. Check the voltages between L1-L2, L1-L3 and L2-L3. These voltages should be within 2% of each other and within +10% of the rated three-phase line-to-line voltage.
2. If these voltages are extremely low or widely unbalanced, check the power system to determine the cause of the problem.
3. If the voltages are within range, use a phase tester to verify that phases are in A, B, C sequence for L1, L2 and L3. Correct rotation is required for compressor operation. If incorrect phase sequence is indicated, turn off the power and interchange any two of the supply power leads at the disconnect switch.

This can be necessary as the phase/voltage monitor is sensitive to phase reversal. Turn on the power. The output relay should now close after the appropriate delay.

Compressor short cycling protection

The MicroTech II controller contains logic to prevent rapid compressor restarting. Excessive compressor starts can be hard on starting components and create excessive motor winding temperatures. The anti-cycle timers are set for a five-minute stop-to-start cycle and a 20-minute start-to-start cycle. Both are adjustable through the MicroTech II control.

There is also a timer with a 5 minute default for minimum time between any two circuit starts.

Controls, Settings and Functions

Table 34, Controls

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION
Compressor Heaters	To provide heat to drive off liquid refrigerant when compressor is off.	HTR1-COMPR	On, when compressor is off.	N/A	On the Compressor
Compressor Solenoid - Load	Loads compressor	LOAD	N/A	N/A	On the Compressor
Compressor Solenoid - Unload	Unloads the compressor	UNLOAD	N/A	N/A	On the Compressor
Evaporator Heaters	Help prevent evaporator freeze-up	HTR-EVAP	38°F (3.3°C)	N/A	Water Heads
Electronic Expansion Valve Board	To provide power and step control to the EXV stepper motors commanded by the MT II.	EXV-DRIVER	N/A	N/A	Control Panel
Electronic Expansion Valve	To provide efficient unit refrigerant flow and control subcooling.	EXV	In Controller Code	N/A	In Main Liquid Line
Solid State Starter Thermistor Card	To provide motor temperature protection at about 220°F (104°C).	K2 Fault	None, Inherent in design	Auto	Power Panel
Mechanical High High Pressure Switch	For UL, ETL, etc.,...safety code to prevent high pressure above the relief valve.	MHPR	Refer to OM AGS	Auto	Control Panel
MicroTech II Unit Controller	To control unit functions. Refer to OM AGS.	UNIT CONTROLLER	N/A	Refer to OM AGS	Control Panel
MicroTech II Circuit Controller	To control individual circuit functions. One per circuit. Refer to OM AGS.	CIRCUIT CONTROLLER	N/A	Refer to OM AGS	Control Panel
Phase Voltage Monitor	To prevent reverse rotation of the motor and protect it from under/over voltage.	PVM	N/A	Auto	Power Panel
Oil Return Solenoid	Controls oil flow from evaporator to compressor and controls discharge superheat	OIL RETURN SOLENOID	Closed when compressor is off	N/A	Oil line from evap to compressor
Oil Level Sensor	Senses oil level in the oil separator	OLS	NC with oil present	N/A	Oil Separator
Differential Pressure Switch	Pressure difference from compressor discharge to oil entering compressor.	DPS	25 psig		Condenser Coil Support
Fan VFD	Controls discharge pressure	FAN VFD	In controller code	N/A	Power Panel
Control Panel Heater	Maintain controller operation	HTR- CONTROL BOX	On at 40°F	N/A	Control Panel
Lightning Arrestor	To protect from high voltage spikes and surges.	LA	N/A	N/A	Power Panel
Oil Separator Heaters	Provide heat to maintain viscosity at low temperatures	HTR 6-13	On when compressor is off and oil level is present	N/A	Oil Separator
Low Pressure Switch	Protects compressor from running with insufficient oil pressure	LPS	Refer to OM AGS	Auto	

Troubleshooting Chart

Table 35, Troubleshooting

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor will not run.	<ol style="list-style-type: none"> 1. Main power switch open. 2. Unit S1 system switch open. 3. Circuit switch, CS in pumpdown position. 4. Chilled water flow switch not closed. 5. Circuit breakers open. 6. Fuse blown or circuit breakers tripped. 7. Unit phase voltage monitor not satisfied. 8. Compressor overload tripped. 9. Defective compressor contactor or contactor coil. 10. System shut down by protection devices. 11. No cooling required. 12. Motor electrical trouble. 13. Loose wiring. 	<ol style="list-style-type: none"> 1. Close switch. 2. Check unit status on MicroTech II display. Close switch. 3. Check circuit status on MicroTech II display. Close switch. 4. Check unit status on MicroTech display. Close switch. 5. Close circuit breakers. 6. Check electrical circuits and motor windings for shorts or grounds. Investigate for possible overloading. Check for loose or corroded connections. Reset breakers or replace fuses after fault is corrected. 7. Check unit power wiring to unit for correct phasing. Check voltage. 8. Overloads are manual reset. Reset overload at button on overload. Clear alarm on MicroTech II display. 9. Check wiring. Repair or replace contactor. 10. Determine type and cause of shutdown and correct problem before attempting to restart. 11. Check control settings. Wait until unit calls for cooling. 12. See 6,7,8 above. 13. Check circuits for voltage at required points. Tighten all power wiring terminals.
Compressor Noisy or Vibrating	<ol style="list-style-type: none"> 1. Compressor Internal problem. 2. Oil injection not adequate. 	<ol style="list-style-type: none"> 1. Contact McQuayService. 2. Check that oil line sight glass is full during steady operation. Check pressure drop across oil filter and oil separator sight glasses.
Compressor Overload K2 Tripped or Circuit Breaker Trip or Fuses Blown	<ol style="list-style-type: none"> 1. Low voltage during high load condition. 2. Loose power wiring. 3. Power line fault causing unbalanced voltage. 4. Defective or grounded wiring in the motor. 5. High discharge pressure. 	<ol style="list-style-type: none"> 1. Check supply voltage for excessive voltage drop. 2. Check and tighten all connections. 3. Check supply voltage. 4. Check motor and replace if defective. 5. See corrective steps for high discharge pressure.
Compressor Will Not Load or Unload	<ol style="list-style-type: none"> 1. Defective capacity control solenoids. 2. Unloader mechanism defective. 	<ol style="list-style-type: none"> 1. Check solenoids for proper operation. See capacity control section. 2. Replace.
High Discharge Pressure	<ol style="list-style-type: none"> 1. Noncondensables in the system. 2. Fans not running. 3. Fan control out of adjustment. 4. System overcharged with refrigerant. 5. Dirty condenser coil. 6. Air recirculation from fan outlet into unit coils. 7. Air restriction into unit. 8. Oil separator plugged. 	<ol style="list-style-type: none"> 1. Purge the noncondensables from the condenser coil after shutdown. 2. Check fan fuses and electrical circuits. 3. Check that fan setup in the controller matches unit fan number. Check MicroTech II condenser pressure sensor for proper operation. 4. Check for discharge superheat less than 15°F. Remove the excess charge. 5. Clean the condenser coil. 6. Remove the cause of recirculation. 7. Remove obstructions near unit. 8. Check oil separator pressure drop.
Low Discharge Pressure	<ol style="list-style-type: none"> 1. Wind effect or a low ambient temperature. 2. Condenser fan control not correct. 3. Low suction pressure. 4. Compressor operating unloaded. 	<ol style="list-style-type: none"> 1. Protect unit against excessive wind into vertical coils. 2. Check that fan setup in the MicroTech II controller matches unit fan number. Check SpeedTrol fan on units with SpeedTrol option. 3. See corrective steps for low suction pressure. 4. See corrective steps for failure to load.
Low Suction Pressure	<ol style="list-style-type: none"> 1. Inadequate refrigerant charge quantity. 2. Clogged liquid line filter-drier. 3. Expansion valve malfunctioning. 4. Insufficient water flow to evaporator. 5. Water temperature leaving evaporator is too low. 6. Evaporator tubes fouled. 7. Suction valve (partially) closed. 8. Glycol in chilled water system. 	<ol style="list-style-type: none"> 1. Check liquid line sightglass and evaporator sightglass. Check unit for leaks. Repair and recharge to clear sightglass. 2. Check pressure drop across the filter-drier. Replace filter-driers. 3. Check expansion valve superheat and valve opening position. Replace valve only if certain valve is not working. 4. Check water pressure drop across the evaporator and adjust gpm. 5. Adjust water temperature to higher value. 6. Inspect by removing water piping. Clean chemically. 7. Open valve. 8. Check glycol concentration.
Differential Pressure Switch Trips	<ol style="list-style-type: none"> 1. Clogged filter-drier. 2. Clogged oil separator. 3. Separator outlet valve (partially) closed. 	<ol style="list-style-type: none"> 1. Check pressure drop, replace. 2. Clean or replace. 3. Open valve.
Low Oil Level Trip	<ol style="list-style-type: none"> 1. Insufficient oil. 2. Low discharge pressure. 	<ol style="list-style-type: none"> 1. Check oil line and separator sight glasses. 2. Possible overcharge or faulty EXV.
High Suction Pressure	<ol style="list-style-type: none"> 1. Excessive load - high water temperature. 2. Compressor unloaders not loading compressor. 3. Superheat is too low. 	<ol style="list-style-type: none"> 1. Reduce load or add additional equipment. 2. See corrective steps below for failure of compressor to load. 3. Check superheat on MicroTech II display. Check suction line sensor installation and sensor.

Periodic Maintenance Log

Date of inspection: _____		Address: _____	
Facility/job name: _____		City/State: _____	
Unit model number: _____		Physical location of unit: _____	
Unit serial number: _____		Service technical (name): _____	
Software identification:			
Operating hours:	Compressor #1 _____	Compressor #2 _____	Compressor #3 _____
Number of starts	Compressor #1 _____	Compressor #2 _____	Compressor #3 _____
Follow up service required: Yes <input type="checkbox"/> No <input type="checkbox"/>			

General Actions to be Taken

Upper part of report completed: Yes ☐ No ☐ Fill in above

Compressor operation:	Yes	No	Explain all "No" checks
1. Mechanical operation acceptable (noise, vibration, etc.)?	<input type="checkbox"/>	<input type="checkbox"/>	_____
2. Look at cycling and cooling, is unit controlling at set points?	<input type="checkbox"/>	<input type="checkbox"/>	_____
3. No refrigerant leaks (full liquid sight glass)?	<input type="checkbox"/>	<input type="checkbox"/>	_____
4. Liquid line moisture indicator shows dry system?	<input type="checkbox"/>	<input type="checkbox"/>	_____
5. Proper condensing fan operation?	<input type="checkbox"/>	<input type="checkbox"/>	_____
6. Condenser coil clean?	<input type="checkbox"/>	<input type="checkbox"/>	_____
7. No corrosion or paint problems?	<input type="checkbox"/>	<input type="checkbox"/>	_____
Compressor electrical operation:			
8. Satisfactory electrical operation?	<input type="checkbox"/>	<input type="checkbox"/>	_____
9. MicroTech II hardware operation satisfactory?	<input type="checkbox"/>	<input type="checkbox"/>	_____
10. MicroTech II software operation satisfactory?	<input type="checkbox"/>	<input type="checkbox"/>	_____

Data from MicroTech II Controller:

11. Unit status _____ %	Circuit status 2 % Capacity	Circuit status 3 % Capacity	
12. Circuit status 1 % Capacity	Entering/Leaving /		
13. Water temperature – Evaporator:	Circuit #1	Circuit #2	Circuit #3
14. No. of fan states active:	_____	_____	_____
15. Evaporator pressure:	_____	_____	_____
16. Condenser pressure:	_____	_____	_____
17. EXV position – Steps open or percent open:	_____	_____	_____
18. Superheat:	_____	_____	_____
19. Subcooling:	_____	_____	_____
20. Liquid line temperature:	_____	_____	_____
21. Chiller % rated load amps – Unit:	_____	_____	_____
22. Outside air temperature:	_____	_____	_____
23. Leaving evaporator setpoint temperature:	_____	_____	_____
24. Reset option programmed? Yes <input type="checkbox"/> No <input type="checkbox"/>	Ice storage unit? Yes <input type="checkbox"/> No <input type="checkbox"/>		
25. Is VFD included? Yes <input type="checkbox"/> No <input type="checkbox"/>	VFD operation OK? Yes <input type="checkbox"/> No <input type="checkbox"/>		
26. Current alarm: _____	Circuit #1 _____	Circuit #2 _____	Circuit #3 _____
27. Previous alarm – Show all:	Alarm Type	Date	
	Circuit #1	_____	_____
		_____	_____
	Circuit #2	_____	_____
		_____	_____
		_____	_____
	Circuit #3	_____	_____
		_____	_____
		_____	_____

Data at Job Site:

28. Volts:	L1 _____	L2 _____	L3 _____
29. Amps: Comp #1	Ph 1 _____	PH 2 _____	PH 3 _____
30. Amps: Comp #2	PH 1 _____	PH 2 _____	PH 3 _____
31. Amps: Comp #3	PH 1 _____	PH 2 _____	PH 3 _____
32. Vibration – Read every six months using IRD (or equal) unfiltered at flat on top of motor end:	_____ In/Sec Comp #1	_____ In/Sec Comp #2	_____ In/Sec Comp #3

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to **www.mcquay.com**.

